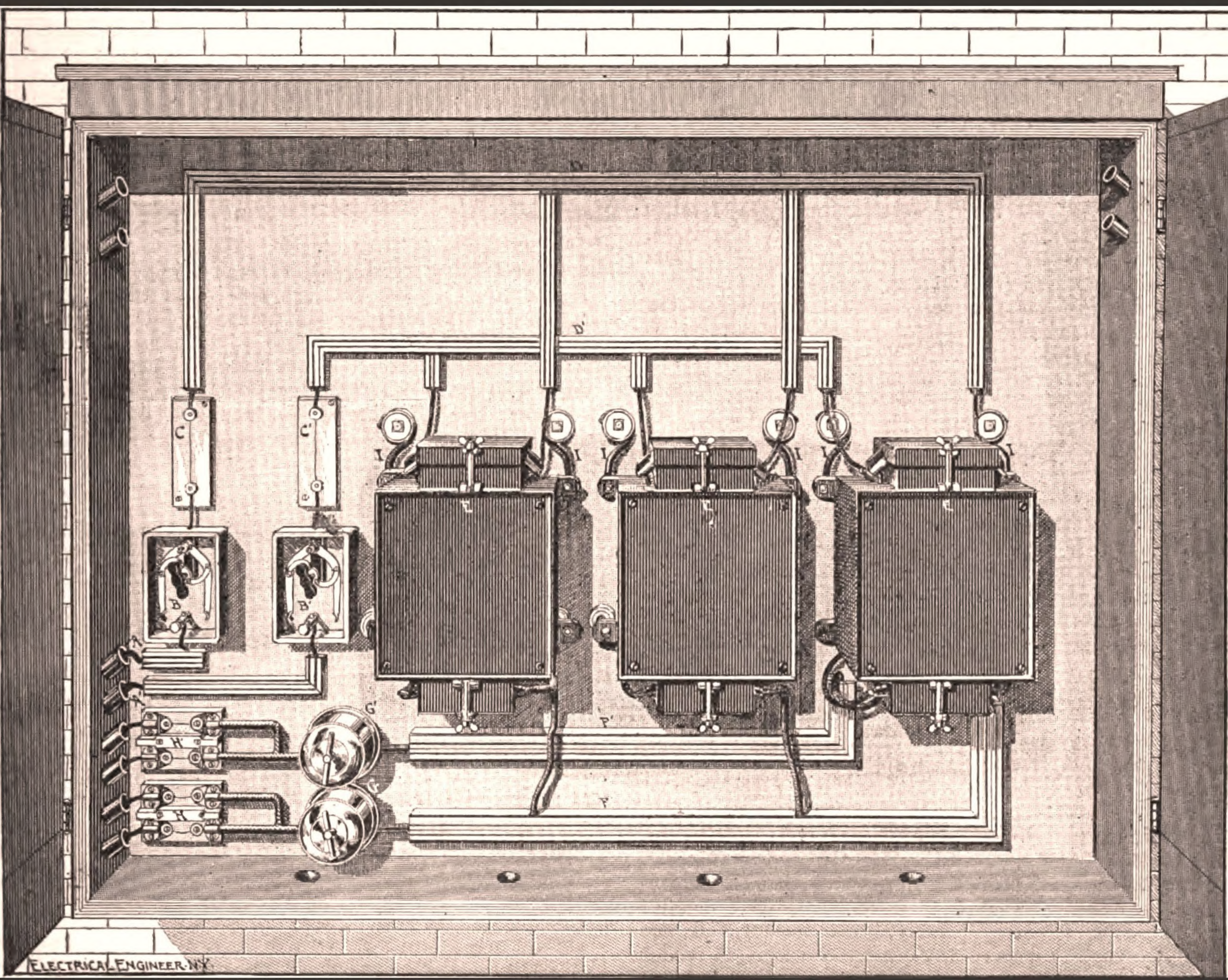

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Alphabetical Index of Contents.

A denotes Articles. ***A** denotes Illustrated Articles. **Ax** denotes Abstracts and Extracts. ***Ax** denotes Illustrated Abstracts and Extracts.
E denotes Editorials. **L** denotes Letters to the Editor. **L N** denotes Legal Notes. **N** denotes News and Notes.
R denotes Reviews of Books. **T N** denotes Trade Notes and Novelties and Mechanical Department.

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T. COMMERFORD MARTIN AND JOSEPH WETZLER.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.
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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

VOL. X. NEW YORK, JULY 2, 1890. No. 118

Notwithstanding the losses necessarily incurred by the use of an accumulator, the latter is an economy in private installations, and no doubt eventually for public supply.—Sir D. Salomons.

WATER POWER ELECTRIC MOTOR SERVICE.

OUR recent article on some of the results obtained by Mr. G. A. Redman, at Rochester, in the introduction of the electric motor, has, we are glad to find, awakened very general interest. It will be remembered that the Rochester Brush Electric Light Company utilizes the lower falls of the Genesee river. It has built up a large lighting business and has now turned its attention to power with such success that it has already over 500 motors in active service. We mentioned as one example of the manner in which the business had been worked up that the company was furnishing power to no fewer than 108 tailor shops.

Several inquiries have been addressed to us on the subject, and the question that seems to arouse most interest is that of rates. We are glad to be able to give the information required, and in doing so would point out that the ruling idea has been to build up a good business at a steady income. Another point deserving comment is that Mr. Redman has attained his results on arc circuits which have not always, so far, been the best to work upon, owing to obvious difficulties with many of the motors hitherto obtainable. The rate charged at Rochester for one-eighth h. p. for sewing machines is $18 per annum. A special rate of $15 for a one-eighth is made for fan service, for the season, from June 1 to October 1. In view of the fact that such fan motors are practically kept at it without cessation during that season, the charge is very reasonable. At any rate it is cheerfully paid, and in cases of sickness the motor has been such an inestimable boon that the customers were willing to pay any price for it. For a one-half h. p. motor the fan service rate is $35 for the season; and $50 for one h. p. For the half h. p. on ordinary work, the yearly rate is $48, and for the one h. p., $72. In other words, for 25 cents a day, a small manufacturer, printer, tailor, or storekeeper has one h. p. always at his command without bother or thought or attention on his part; and the amount of work that a steady one h. p. will do is not fully realized. It is this easy command of cheap power in small units that, in our opinion, is destined to bring about some notable industrial changes in due time.

Coming to the larger sizes, we find that Mr. Redman gets $120 per annum for two h. p.; $250 for five; $300 for six; $400 for eight; $475 for ten and $700 for fifteen. The last quotation brings the rate down to only a little over $46 per horse-power per year. What better can a manufacturer using 15 h. p. ask than such a rate, which gives him the fullest power he is paying for, by the mere closing of a switch, and upon the instant?

We hope to see the Rochester results duplicated elsewhere; in fact we know of several instances where the utilization of the water power in this manner will be among the most striking advances of the time in this field. It is no longer necessary to huddle together down in the unhealthy valley, close to the turbid stream, on ground that costs as much as the mills built upon it. The power developed by the water can be delivered miles away in the smallest as well as the largest quantities, under conditions favorable to the well-being of the employés and to the higher perfection of the factory product.

ELECTRIC RAILWAY WORK ABROAD.

ONE of the leading electrical engineers in England, who has done splendid pioneer technical work in electrical railroading, writes us in a grimly humorous way about the conditions that have to be contended with there. Overhead conductors roads would not be allowed, he says, though for the life of us we cannot see why. He goes on, however, as follows :—

"Even if accumulators were dirt cheap and almost everlasting, we must have acts of Parliament—a separate one for each road—which are costly, and take time to get. Then comes the question, who is to obtain those Acts? The tramway company, or the contractors for the plant?"

Fancy going to Congress, or even to a State Legislature, every time we wanted to build an electric road! That would be too much even for American patience and grit.

"After the Parliamentary Act come the vestries, and local boards who are, to say the least of it, mostly ignorant humbugs, existing principally for the purpose of retarding progress. These corporations cling to all the traditions of of centuries ago. But the worst of all are the tramway companies themselves. Of these there are about 70 in these Islands. Sixty of these are paupers, don't pay a decent dividend, haven't a penny to spare, dare not increase capital without more Acts of Parliament, ask you to find everything, and then perhaps allow you to make a handsome profit for their stockholders without any thanks. I could write a history of many pages—sad, pathetic and comical,—on this subject and on my interviews during the past 7 or 8 years with M. P.'s, tramway directors and managers, mayors, vestrymen, Board of Trade officials and gangs of other individuals. You Americans are a different

sort of humanity. I am longing for the next opportunity to cross the Atlantic and shake you all by the hands—good, honest, appreciative hands."

All one can reply to such an outburst as this, is:—"Come over and join us!" It is not all an easy victory here, and we still have street railway men who in convention ridicule electricity and prefer to discuss the disposition of manure; but still we do see some return for the work done, and the rapidity of growth in the field of electric locomotion taxes one to keep pace with it.

Even our negotiable boards of aldermen would rather vote for electricity than against it; and if they oppose it they have something more tangible as an argument governing their action than mere blind and stupid prejudice.

It seems to us, however, that the change of front that our correspondent longs for and has worked for in England, is not very far away; and, if it be, the Continent is certainly ripe for the new departure. Our information is such as to lead us to believe that this year will see great activity in Europe in electric railroading, and that Americans will take a share in it.

TRANSFORMER PHENOMENA.

The appearance of the alternating current transformer in the field of practical electricity was naturally accompanied by searching inquiries as to the exact phenomena manifested in its operation and their effects on its regulating qualities, which of course involve its efficiency. It was soon determined that that early bugbear of the continuous current armature, Foucault currents, required the adoption of special precautions in the direction of increased lamination of the iron. But besides this, another phenomenon, before but dimly recognized, acquired prominence at once, and an importance second only to that of the Foucault currents. It is now known as hysteresis. While the precautions necessary to avoid losses by Foucault currents are easily applied, those demanded for the suppression of losses by hysteresis are by no means as simple, depending as they do upon the quality of the iron, and being independent largely of its state of sub-division. Again, as experience soon showed, the losses from hysteresis depended also to a very great extent upon the degree of magnetization at which the iron was worked, the losses increasing with the increased density of lines of force per unit area.

Study in this work is fortunately still being carried on. The results of recent experiments continue to throw more light upon the transformer, and, we are glad to note, they indicate that improvement in its manufacture is going on steadily. This is well demonstrated in the paper read by Messrs. Humphrey and Powell before the American Institute of Electrical Engineers, which we print elsewhere. While the initial experiments in this direction made at Cornell were carried out on a 10-light transformer, the later ones were effected with a 40-light transformer of the same general design, but of more recent manufacture. The result shows that whereas the 10-light transformer had an efficiency of 86 per cent. at normal load, and an "all-day efficiency" of about 40 per cent., the 40-light transformer reached an efficiency of 96.2 per cent. at normal load, and the high "all-day efficiency" of 90 per cent.

This remarkable result can evidently only be attributed to the improvement in the grade of the iron employed, although the larger capacity of the transformer may have contributed to some extent to the increased efficiency, as is usually the case in electro-magnetic machinery. It is curious to note, however, that while in the 10-light transformer paper insulation was used between the laminæ of iron to suppress the Foucault currents, the insulating skin of the laminæ alone was found sufficient to effect the desired result in the 40-light transformer. The relations which the primary and secondary currents and E. M. F.'s bear to one another under different loads and conditions are very graphically brought out in the paper referred to, and suggest the lines on which further improvement may be looked for.

Taking up the subject of transformers from another standpoint, Prof. Harris J. Ryan, at the same meeting of the Institute, discussed phenomena which have created considerable interest in many quarters. Our readers will remember that some time ago Mr. E. G. Acheson, of Pittsburg, announced the discovery by him that the output of the transformer could be considerably augmented by the heating of the core. The most natural explanation of this was to ascribe it to the increase in the permeability of the iron at the increased temperature. But while this is true to some extent, Prof. Ryan shows that the principal phenomenon to be taken into account here is that of the Foucault currents; and he further shows that the heating of the core increases the electrical resistance to such an extent that these currents are almost entirely suppressed. Prof. Ryan also points out the probable reason why converters of the special form illustrated in his paper are subject to considerable variation in the ratio of the primary to the secondary E. M. F., namely, as being due to the fact that the induction through the air space is a variable quantity, depending upon the load. We hope that these experiments will be carried out at greater length, until the exact useful limitations of the "heated core" converter are determined.

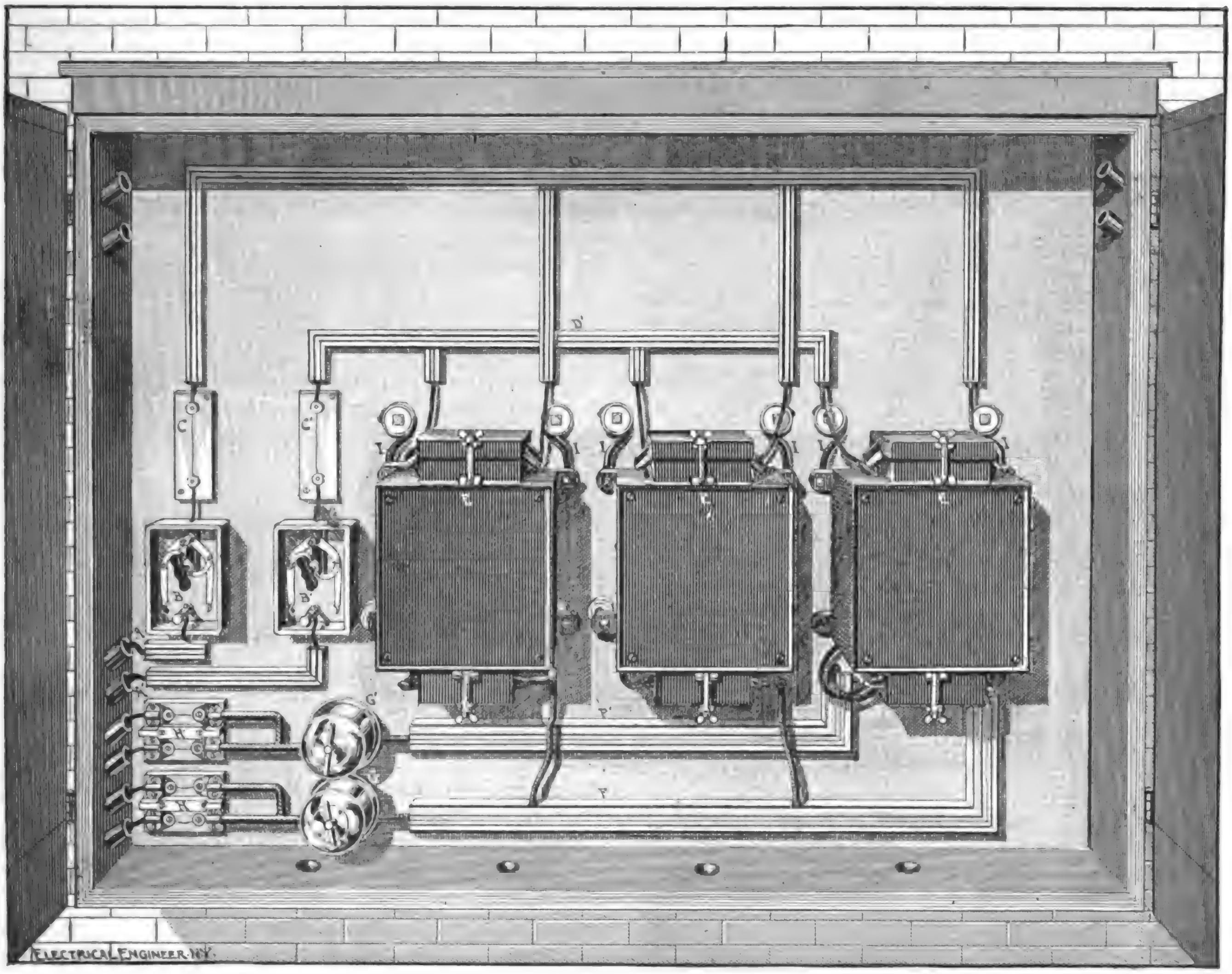
Converter Cabinets.

The steady improvement that is seen on all sides in the insulation of lines and apparatus for light and power is a sure sign that the industry has passed beyond the stage when it was supposed that anything would do. The real fact is that to-day the standard is higher in electric lighting, for the nature of the work, than in telegraphy and fully as high as in telephony. The old idea that good insulation was too costly is scouted, after having done mischief enough to blast any industry not possessed of the inherent vitality and superiority exhibited by electric lighting. Cheapness does not necessarily mean ruin, but where it is the only end sought, disaster and failure are inevitable. It is, of course, in cities where the conditions are so exacting that the advances are first seen, and every-one must admit how great those advances are, especially in the work for the introduction of the alternating incandescent light. We illustrate this week an arrangement worked out by Mr. John A. Seely, and now being adopted by the Harlem Lighting Company, of this city, for the housing of converters and accessory apparatus. The methods adopted to insure safety in every respect must, if carried out generally, remove the last chance for an accident. The spirit that prompts to work of this character is commendable, and we hope to see a good deal done in this direction.

THE NEW CONVERTER CABINET OF THE COMPLETE ELECTRIC CONSTRUCTION CO.

In many towns of a limited number of inhabitants the practice is frequently followed of attaching the converters used in the alternating current system of distribution to poles, and running the distributing wires to the premises where the light is being used. While this method presents no serious obstacle in such cases, it is evidently unsuited to application in a large city and other methods must be employed. This is more particularly the case where the distribution is an underground one, and the wires are led into the premises by cables. The converters being thus in close proximity to the dwellings, it becomes necessary to take due precaution to prevent accidents of all kinds, and which is lined on the inside with asbestos cloth, dressed with a coating of the new insulating compound, "Seeline," and covered on the top with canvas, thus making the entire supporting structure fire-proof and water-tight.

The primary wires from the high tension mains are brought in through the inlets A A¹ and pass into the primary switches B B¹ designed by Mr. Barberie, and the construction of which will be described presently. Immediately beyond the switches are the fusible cut-outs C C¹ which are placed vertically, and from there the current passes by the leads D D¹ to the converters E E E, also, as usual, provided with the primary cut-outs at the tops of the box. The secondary currents after passing through the fusible cut-outs at the bottom of the converters, pass



Converter Cabinet for Buildings in Cities.

in carrying out this idea the work which is now being installed in this city in connection with the Harlem Lighting Co. is worthy of attention, as embodying undoubtedly ingenious, correct and well approved methods of construction, and which must place this system of distribution practically beyond the danger of an accident.

The entire interior wiring for the Harlem Lighting Co. is carried out by the Complete Electric Construction Co. of this city, of which Mr. John A. Seely is the electrician and general manager. The means by which safety is insured are obtained by enclosing the entire complement of converters, switches and cut-outs in a box or cabinet which is shown in the accompanying illustration. Such a box is placed in the vault of each building to be lighted, outside of the building line. The box is constructed of wood, into the leads F F¹ and thence into the secondary switches G G¹ which control the house service, and thence into the cut-outs H H¹ to the lamp circuits. The house service here shown is arranged to provide for two circuits, the conductors, it will be seen, being split after leaving the switches G G¹, each circuit passing through its individual cut-out.

The primary switches B B¹, it will be noted, are placed beyond the fusible cut-outs so that a fuse can be replaced at any time without danger by opening the switches. These switches, as will be seen, are of peculiar construction, the object being to secure an absolute break of considerable length, so that on opening them the underground line can be tested with absolute certainty. The switch has a pair of arms which are controlled by a switch

handle and when brought together clasp a knob to which the primary circuits are connected. Our engraving shows the switches open, the position in which the test would be made. These switches, as well as all others within the box, are mounted on indestructible insulating bases, and the leads run in moldings wherever possible. The converters it will be noticed are suspended from insulators by means of iron hooks I I.

To provide for a thorough ventilation of the box, it is perforated with air holes at the bottom, and similar vents at the top of the box and the sides permit of a free circulation of air.

With the thorough construction embodied in the box described above, it is evident that every precaution has been taken which practice and experience have dictated, and we hope to see all the work of this nature carried out in an equally substantial manner.

THE EDISON SYSTEM OF UNDERGROUND ELECTRIC TUBES.

It is now nearly ten years ago that the first Edison underground tubing was laid in the streets of New York, and what was then a bold experiment rapidly developed into regular practice, so that to-day we find hundreds of miles of the Edison tubing in successful practical operation. Although the lines originally laid down by Mr. Edison have not been departed from in any essential manner, the practice of the art has gradually advanced and effected changes in detail which have brought the system to its present state of perfection. With the object, therefore, of affording our readers information as to the latest improvements and methods of installing the system, we give below a description of the same as it exists to-day and for which we are indebted to the courtesy of the Edison General Electric Co.

An electric tube consists of one or more conductors contained in and insulated from an iron pipe. In the three-wire system which we propose to describe, three copper rods are placed in each pipe. The system is a sectional one, and each tube is as complete when it leaves the factory as is a rail from a rolling mill. Like a rail it needs only to be joined to other similar units to become part of a continuous line.

In the three-wire system of distribution the conductors, whether overhead or underground, are divided into two classes, viz., feeders which run from the dynamos to centres of distribution and mains which radiate from centres of distribution and loop the ends of the feeders together, constituting the second class. All taps to supply customers with electric current are taken from the mains. Electric tubes are accordingly divided into feeders and mains. A main electric tube, or, more briefly, a main, has three insulated copper conductors of equal size. A feeder electric tube, or feeder, has two principal conductors and one smaller conductor to serve as a neutral wire. A feeder also has three insulated cables of seven No. 19 B. W. G. wires each. These small cables form independent circuits from the station to the point of distribution, and enable one to read in the station the electrical pressure at the outside end of the feeder. Hence these lines are called pressure wires.

The system of numbering electric tubes is based on the Edison wire gauge. The size of any tube is the number of thousand circular mils in its positive or negative conductor. Thus a rod one-half inch in diameter has 250,000 circular mils area, and a tube having three such rods would be a No. 250 main.

Four sizes of pipe are used in the standard Edison tubes, and the range of sizes is given below. All pipe diameters are nominal inside diameters.

80,000	circular mils to	120,000	circular mils in	1½" pipe
150,000	" " "	300,000	" " "	2" "
350,000	" " "	600,000	" " "	2½" "
700,000	" " "	1,000,000	" " "	3" "

The copper rods are all 20 feet 4 inches long, and project from each end of the pipe. All 1½" and 2" pipes are cut 20 feet long, allowing 2" projection of copper; 2½" pipes are cut 19 feet 10 inches long, giving 3" projection; 3" pipes are cut 19' 9" long, giving 3½" projection of rod. The rods are drawn to exact gauge of the finest and purest lake copper, and have a conductivity in excess of 98 per cent. The pipes are the best grade of lap welded steam pipe free from imperfections and of full weight.

Fig. 1 shows sections of standard sizes of mains and feeders. Two additional small mains, No. 67 and No. 41 are made in 1¼" pipe for service work only.

In making up a tube the ends of the copper rods are first chamfered and tinned and the pipe thoroughly cleaned on the inside. Each rod is wound separately with a prepared rope, and three rods so wound are made into a triangular bundle and wound with a fourth rope. This bundle of rods bound with rope is slid into the pipe, which is afterwards filled with insulating compound. A special process insures an entire absence of air bubbles, and the ends of the pipe are closed with rubber plugs. The tube is now tested by means of a delicate Thomson reflecting galvanometer. The tube, after testing, is painted to preserve the iron from rust, and is ready for shipment.

In order to complete the system there is required a means of joining the ends of the conductors in consecutive tubes, and of protecting and insulating such a joint when made.

Fig. 2 shows a joint between two main tubes partially completed. The side on the neutral joint is in position ready to solder. The top coupling joint is being slid into place, while the bottom coppers are untouched.

In Fig. 3 is shown a feeder joint partially completed. In feeder tube joints, after the copper rods forming the main conductors are joined, the pressure wires, referred to in the definition of a feeder, are connected by soldering a wrapped splice, and then taping over the splice with insulating tape. The coupling joint which connects the rods is made of pieces of flexible cable with sockets cast on each end. These sockets are drilled to fit easily over the rods which the joint is to connect. Fig. 4 shows a number of sizes of coupling joints in different views. Shorter and longer joints are made for use in turning corners, and are called elbow joints. Various combinations of elbow joints for different angles are given below. A branch or service joint is for use where a tap is taken from a main line to supply a customer. They differ from other joints in having a socket on one end only, and a round pin-like projection or teat at the other end of the piece of cable. This teat fits into the holes noticed in the sides of the sockets of coupling joints, Fig. 4.

Fig. 5 shows the branch joints and link used on all service connections up to and including 120,000 circular mils area.

Having described the joints for straight lines, bends and branches, we come now to their protection and insulation. For protecting straight work, an iron box made in two halves and called a coupling box, is used.

In Fig. 6 is shown a ball clamp which is bolted around the tube as in Figs. 2 and 3. These clamps are split collars, and grip the tube firmly. The sockets at each end of the coupling box form with the ball of the clamp a ball and socket joint. Ball clamps are made in three styles for use with 3", 2½" and 2" coupling boxes. The 2½" style is made in three sizes for use with 2½", 2", or 1½" pipe. The 2" style is made in two sizes for 2" and for 1½" pipe. A clamp for use on a pipe whose inside diameter is less than that of the largest tube used in the coupling box is called a reducing clamp. Thus a 1½" pipe, when used with a 2½" coupling box, takes a 2½" x 1½" reducing ball clamp.

A 2½" coupling box is shown in Fig. 7. The 3" and 2" coupling boxes do not differ, except as to size. The two halves of the box are bolted together by bolts through the flange. In the top half is a round hole closed by a cast iron cap. Through this hole the box is filled with hot in-

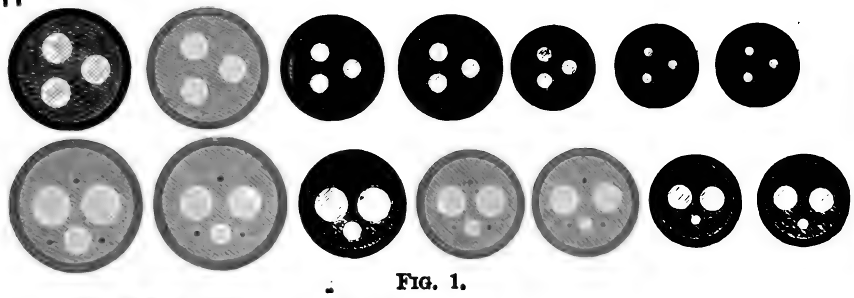


FIG. 1.

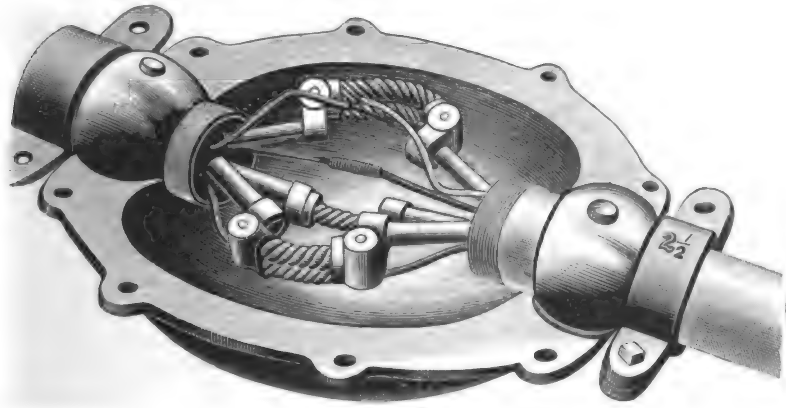


FIG. 3.

FIG. 4.

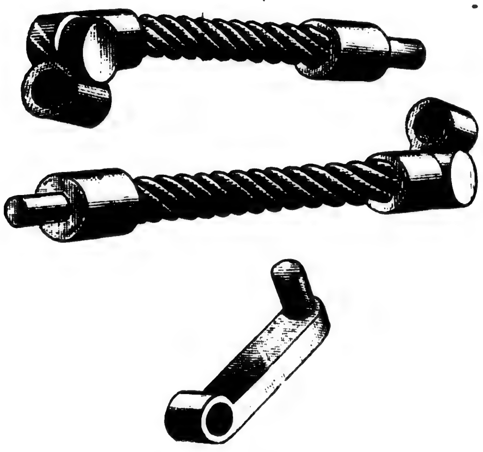


FIG. 5.

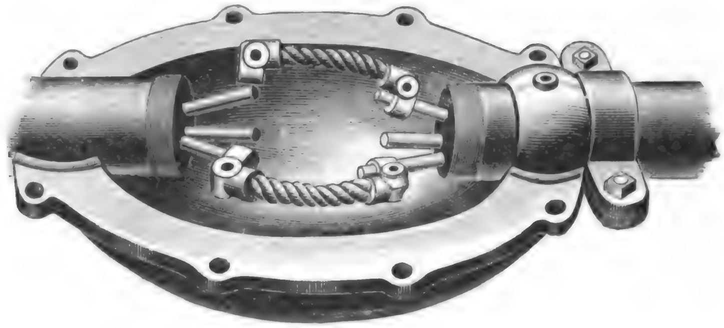
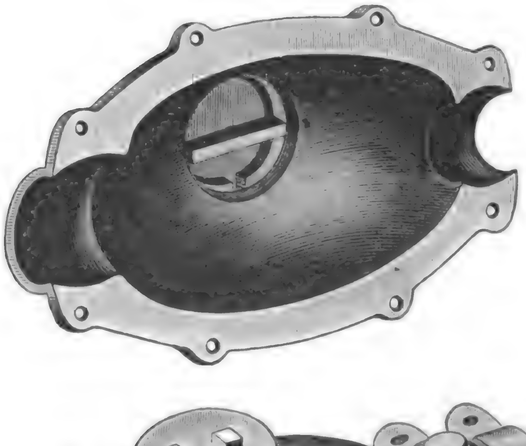


FIG. 2.



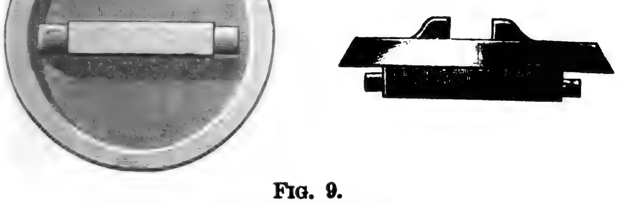


FIG. 9.

FIG. 6.

FIG. 7.

THE EDISON SYSTEM OF UNDERGROUND ELECTRIC TUBES.

sulating compound, which surrounds and insulates the copper rods, the joints, and the tube ends. This compound does not grow brittle on cooling or with age, but remains plastic even at temperatures below the freezing point. An elbow box, 2½″, 90°, is shown partially inclosing an elbow joint between two main tubes in Fig. 8. The 55° and 20° elbow boxes are similar in general design. All elbow boxes allow a range of 18° on either side of their mean position. Thus any angle between 37° and 73° may be made with a 55° elbow box. The 3″ elbows differ from the 2½″ only in being larger. All elbow boxes take special clamps called cup clamps. These clamps have spherical surfaces like ball clamps, but are designed to give a greater range of movement to the ball and socket joint formed with the elbow box. The clamps for the 3″ elbow boxes are similar to the 2½ inch cup clamp shown in Fig. 8. All boxes, whether coupling or elbow, have a round hole in the top half through which they are filled with compound. This hole is closed by a round iron cap which is locked securely in position by turning it through ¼ of a revolution. This cap, shown in Fig. 9, makes a dirt-tight but not air-tight joint, and is called a ventilator top.

Having disposed of the main line, we come to the branches leading to the customer's premises, or, as they are commonly called, the services. These are short lengths of tube which tap the main line by means of a three-way box called a tee box (see Figs. 10 and 11). These boxes are made in two styles, 2″ tee and 2½″ tee, which differ from the 2″ coupling and the 2½″ coupling only in having three nozzles instead of two. Owing to the main portion of a tee being the duplicate of a coupling of the same size, any 2″ coupling or 2½″ coupling may be replaced by a 2″ or 2½″ tee without disturbing the main line. A modified form of tee called a "Y"-box is used where the service makes an angle of 45° with the main line. A four-way or cross-box, really a double tee, admits of two services being taken from one joint.

Mains are so placed in the ground that the positive and negative conductors are on one side of a vertical plane through the centre line of the tube, while the neutral or balancing wire is on the other, as shown in Fig. 12. The side of the tube which the neutral is on is called the inside, because the main tube is so placed that the neutral copper is nearest to the curb line. The feeders are laid symmetrically, with the right hand copper as the positive conductor as the tube leaves the station. Services are never taken from feeder lines. A service to the side of the main line marked inside, and called an inside service, is shown in Fig. 10, while Fig. 11 shows a service to the opposite side, called an outside service. On this basis all services are classed as either outside or inside. The same distinction is made with regard to bends in a main tube, all bends in which the neutral joint is shortened, or before on the inside of the curve, are inside elbows; while those in which the neutral joint is the longest of the three joints, are called outside elbows. The table appended gives the size of service joints required for different service connections, the branch line not being larger than 120,000 circuit mils.

Size of Main Line.	Joints Required for Inside Service.
No. 80 to No. 300.	3 Short Branch Joints.
No. 350 to No. 500.	3 Long Branch Joints.
	For Outside Service.
No. 80 to No. 500.	2 Short & 1 Long Branch Joints, 1 Branch Link

For larger services there is provided a complete tee joint, which consists of the necessary main line coupling joints with the branch joints attached. The combinations of elbow joints given below cover a range of 18° on each side of their mean position.

ELBOW JOINTS FOR MAIN ELBOW.

Style Angle Box.	Joints Required Inside Elbow.			
	Coupling.	Short.	Medium.	Long.
20°	1		2	
55°		1	2	
90°		1		2
	Joints Required Outside Elbows.			
	Coupling.	Short.	Medium.	Long.
20°	2		1	
55°		2	1	
90°		2		1

ELBOW JOINTS FOR ALL FEEDER ELBOWS.

Angle Box.	Positive and Negative Coppers.				Neutral Copper.	
	Coupling	Short.	Medium.	Long.	Medium.	Long.
20°	1		1		1	
55°		1	1		1	
90°		1		1		1

In referring to what constituted a feeder line, it was stated that it was a line from the source of current to some centre of distribution from which mains radiated. This requires that the feeder should be split up or branch out, or, what is the same thing, that it should be connected to two or more mains. The safety catch box is designed to accomplish this object. Inside of a safety catch box all wires of like polarity are connected together, thus allowing the current coming in on one or more lines to split up and supply the remaining lines from which customers obtain their current for light or power. The safety catch box serves then, first, as a centre of distribution; second, as a centre of equalization of electrical pressure between the different parts of the system.

It also affords a ready means of inspecting and testing any line, or of disconnecting a line from the system when work is to be done on it, such as the connection of services, etc. It may be noted here that men thoroughly familiar with the work do not find it necessary to interrupt the current while making service connections.

In Fig. 13 is shown a perspective view of a ten tube safety catch box, *i. e.*, one intended for connection to ten or any less number of lines of tubes. The safety catch boxes are built in three sizes for use with four, six and ten lines respectively. A 4-tube box has four stubs, short lengths of pipe, for connection to as many lines of main tubes. A 6-tube box has four stubs for connection to mains, and two larger stubs for connection to either feeders or mains. A 10-tube safety catch box has eight stubs for connection to mains, and two for connection to either feeders or mains. The top of the box is closed by two covers, the lower of which is bolted down upon a rubber gasket, making a water-tight joint. The upper or top cover, shown in position in Fig. 13, is heavily ribbed and takes the jar and pound of traffic. The engraving, Fig. 14, gives an idea of the general arrangement. The lower half of the jacket has nozzles cast on it into which the short pieces of pipe forming the stubs are screwed. The pipe used for stubs to which mains are to be connected is 2½″ inside diameter, and all the regular 2½″ fittings can be used with

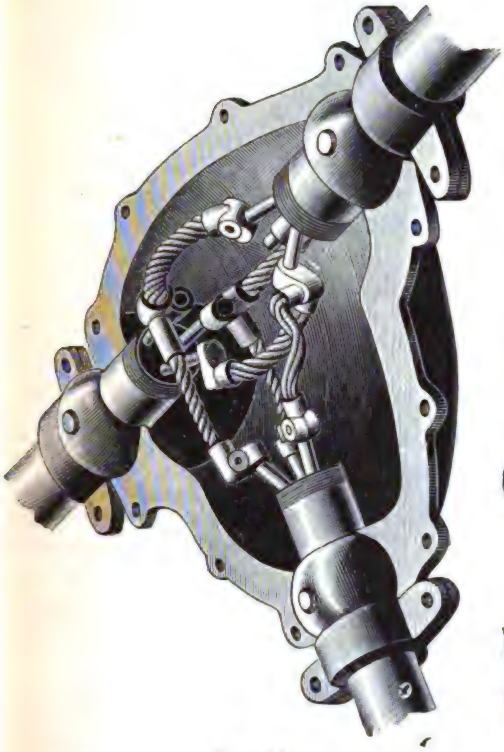


FIG. 10.

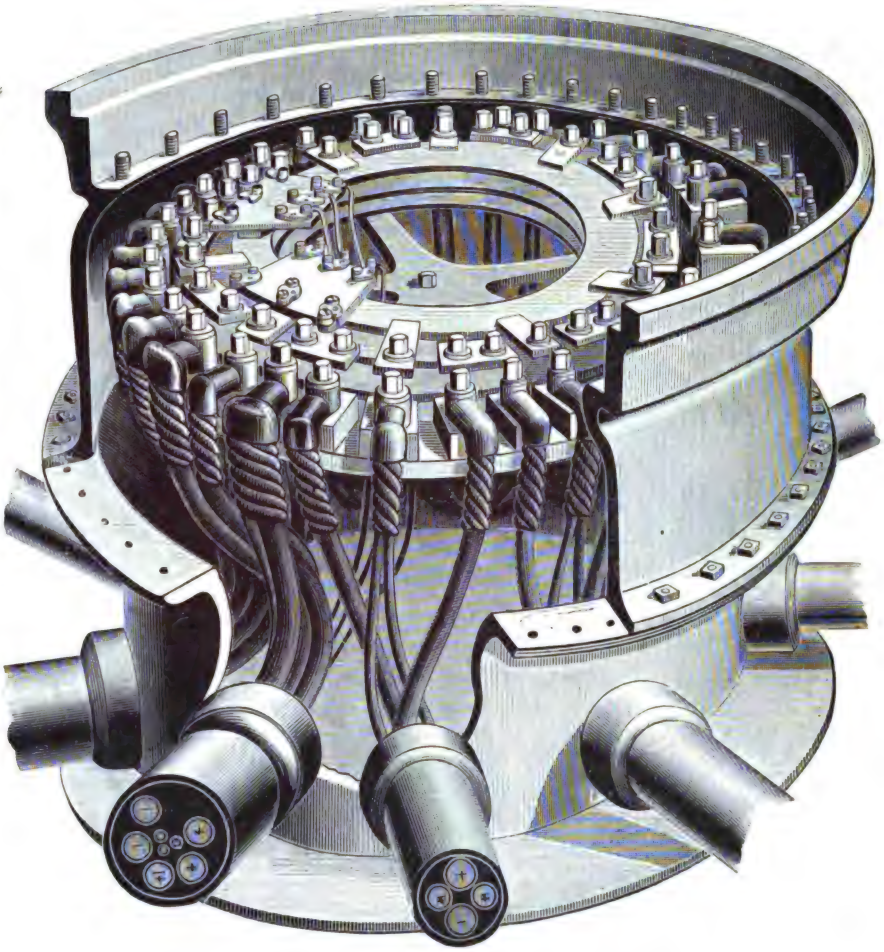


FIG. 14.

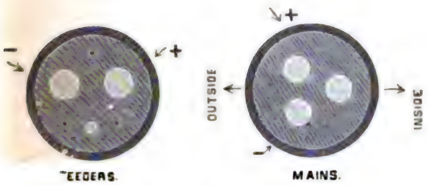


FIG. 12.

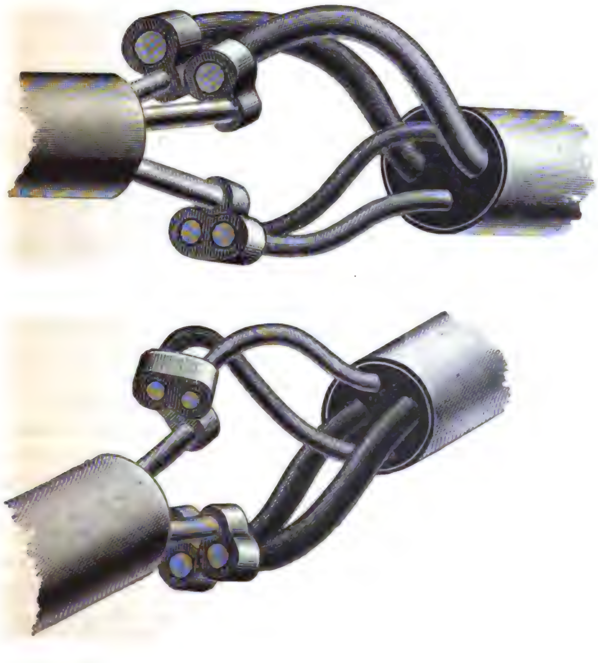


FIG. 15.

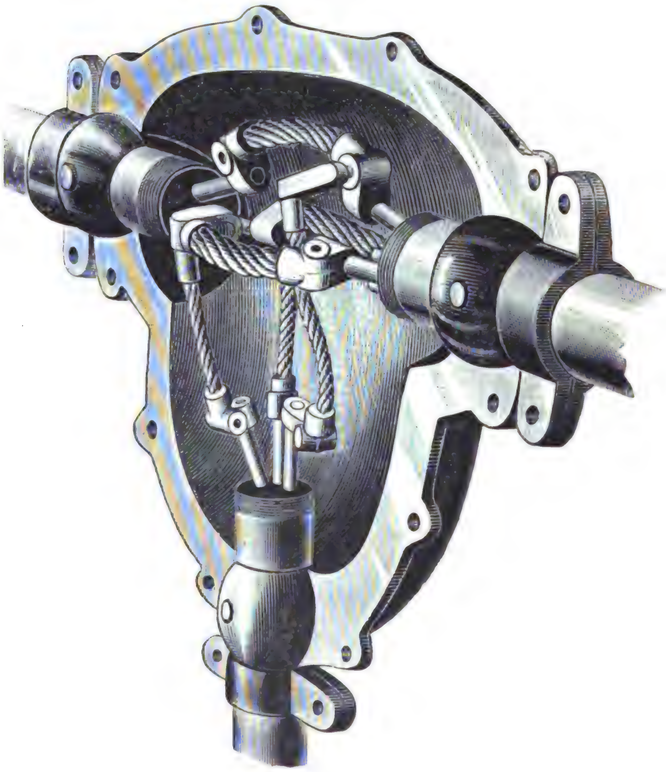


FIG. 11.

THE EDISON SYSTEM OF UNDERGROUND ELECTRIC TUBES.

it. The feeder stubs are of 3½" pipe, and take a special clamp which fits the elbow boxes, and is screwed, and not clamped, onto the stub. The cables in the stubs run to terminals which are connected by safety fuses to copper rings, having terminals opposite to all cable terminals of like polarity. The positive and negative cables in the feeder stubs are of double the size of the neutral cable, because the neutral wire is always smaller than the positive or negative copper, usually only one-third the size of the positive or negative conductor. Fig. 15 illustrates the convenience of splitting the neutral conductor in main stubs. The left-hand figure shows a main with the neutral on the left hand facing the safety catch box, while the

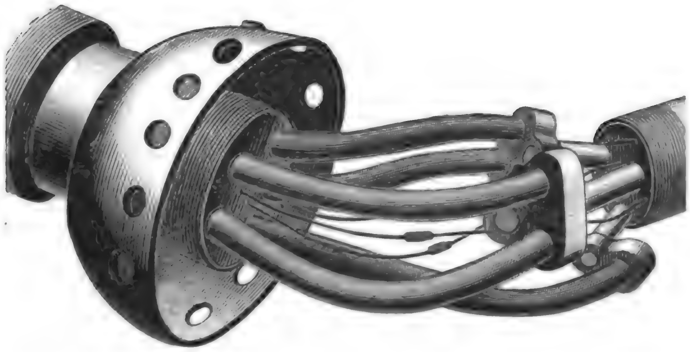
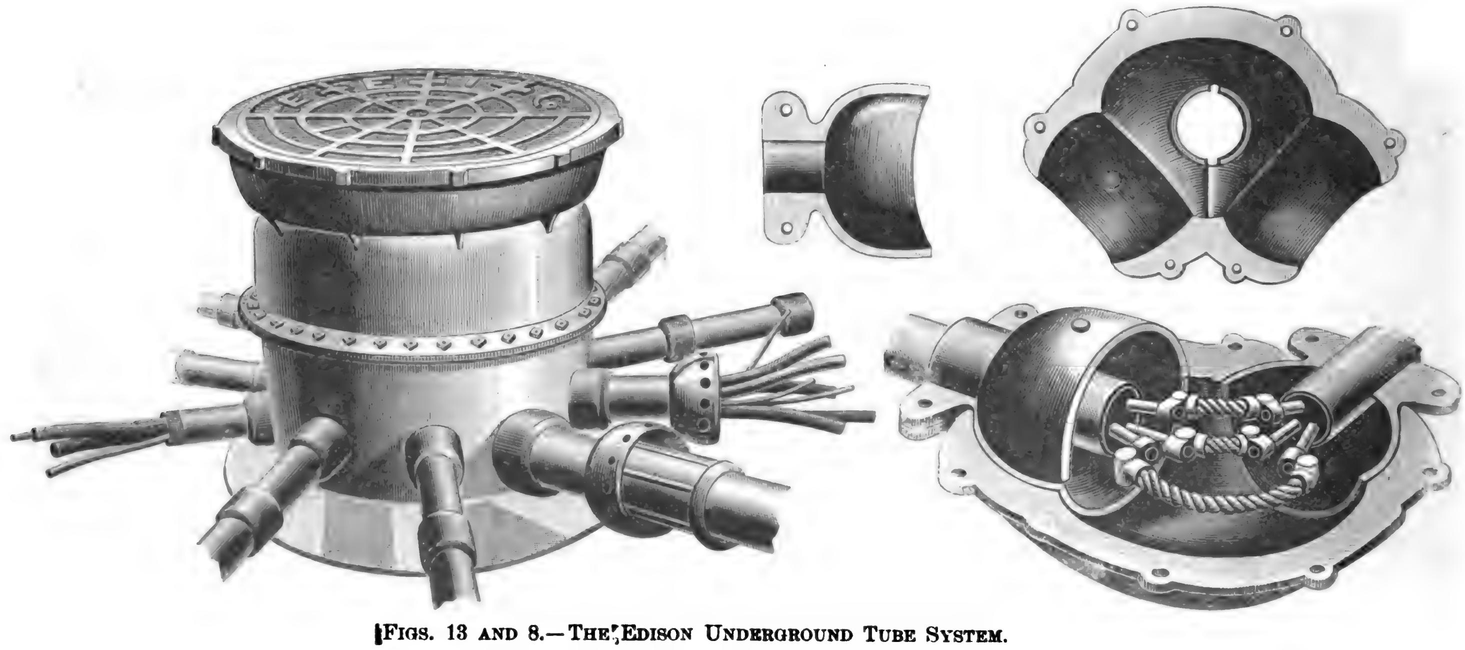


Fig. 16.

other sketch shows a right handed neutral connected to a similar main stub. The top cable in a main stub is always connected to the positive pole of the feeder through the terminals inside the box. Fig. 16 shows a feeder jointed to a feeder stub of a safety catch box. The sockets by which a cable in a stub is connected to a rod in a tube, as shown in Figs. 15 and 16, are called cable sockets. A hard rubber board secured on top of the rings and shown in



Figs. 13 and 8.—The Edison Underground Tube System.

Fig. 14 carries the terminals needed for the small cables running in the feeders and called pressure wires. In this way the electrical pressure at the box can be transmitted through these small cables to the station, and there measured by a suitable voltmeter enabling the attendant to maintain the right pressure under varying loads.

The system may seem burdened with details, but when the consideration comes in that the system takes the current from the dynamo and delivers it to the customer, that a tube is equivalent to three ducts in a conduit and three insulated cables, and that the system has a flexibility far ahead of any underground method of either gas or water distribution, we see that it is, when compared to its work, exceedingly simple. Ten years of experience have enabled the Edison company to produce their standard system of the present freed from the weakness of the original types and have entirely obviated all liability to burn-outs. They manufacture also a complete 2-wire system and a telephone conductor system. They have made many special forms, and are prepared to furnish plans and estimates for any class of underground work.

ELECTRIC MOTIVE POWER ON ELEVATED RAILWAYS, AND ITS PRACTICAL APPLICATION IN CHICAGO.[1]

BY W. N. SMITH.

This thesis is an attempt to show the feasibility of substituting electricity for steam on the elevated roads, as a step toward its general application to longer lines of railway. The historical matter treats of the experiments made on the Manhattan Railway and elsewhere, by Messrs. Leo Daft, F. J. Sprague, and Stephen D. Field.

The principal considerations affecting the problem are discussed in detail, and original designs for the motor and trucks of a motor car, are presented. The writer thinks the motor car preferable to the separate locomotive, and would adopt a 3-wire overhead system, the track being the neutral conductor, and the copper lines being over each track. Each motor car is of about 176 h. p. and will haul two loaded coaches of the usual type.

The power station is equipped with triple expansion engines of 500 h. p. and two multipolar Gramme ring dynamos to each engine. Practical conditions are taken in Chicago, for the three lines now being built there, and the cost of equipment, both steam and electrical, are estimated, on a mathematical basis. It was found that the electrical equipment for ten miles of elevated railway trains to run at a maximum rate of 30 miles per hour, and 3 stops per mile, would cost about $1,078,000 more than the steam equipment; but the saving in fuel by an electrical system would be about $800 per day, with total efficiency, from engine to car axle, of only 55 per cent. Such a system would pay for its extra cost, simply in fuel saving, in less than 4 years; while its other advantages are so obvious that as soon as railroad managers can be convinced of its practicability, electricity will supersede steam.

1. Abstract of Graduating Thesis, Sibley College, Cornell University.

THE EVANS FRICTION CONE IN A COMBINED LIGHT AND POWER PLANT.

Considerable interest is felt among electrical engineers in the system of the Evans Friction Cone Company, of Boston, as an economical and trustworthy means of frictional driving between engines and dynamos. By the use of this system dynamos can either be driven direct from the engine or from counter-shafting when a large engine is used. A remarkable reduction in the space required for an installation is the result, while the efficiency is largely increased by the avoidance of belts, making the driving practically equal to a direct connection.

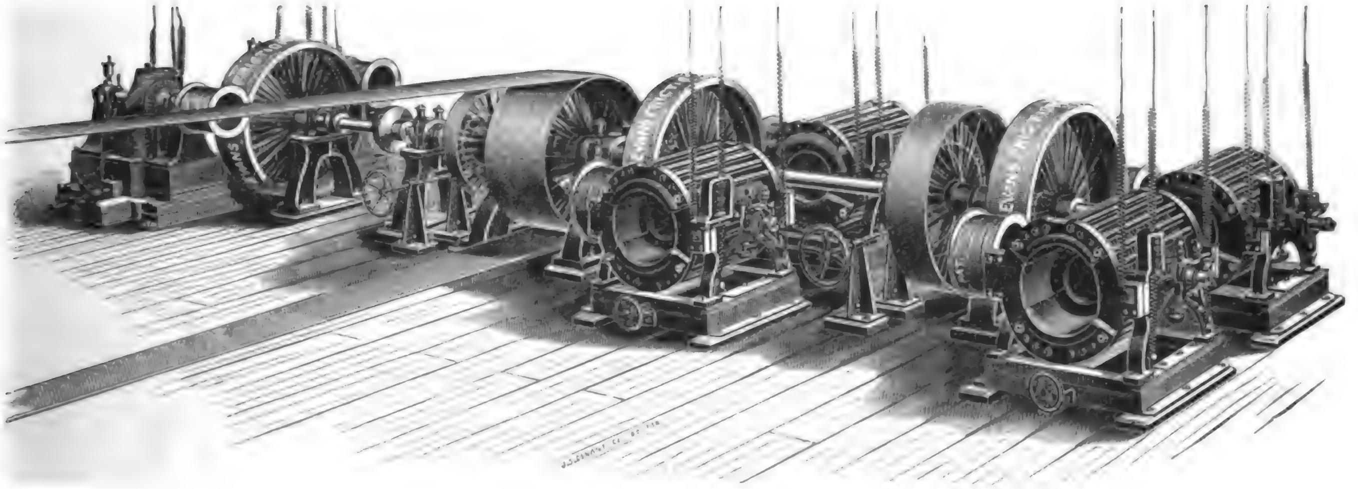
The line shaft shown in the engraving is driven from a compound Ide engine by means of the large belt shown. The two machines at the extreme left of the cut are each 60 h.p. Thomson-Houston railway generators, both running on the same circuit. The power on these two machines varies from practically nothing, to 140 h. p., many times an hour. All of the four dynamos shown at the right are Thomson-Houston "L.D." machines, each with a capacity of 50-1200 c. p. arc lamps, and each machine is fully loaded. The speed of the line shaft is 300 revolutions per minute. The driving pulleys on the line shaft are 50 inches in diameter. The speed of the railway generators is 1150 revolutions and that of the arc dynamos is 820.

The electric company is now putting in another large Ide engine and will belt direct to a continuation of this line of shafting and connect to the present shaft with a clutch coupling. On this continuation more dynamos will be placed and all will be driven by the Evans system. The dynamos, it will be noticed, are arranged so that one pulley drives two machines, and in such a manner that each dynamo can be stopped and started without slowing the engine, independently of the other machines. By putting two dynamos on one pulley the pressure on the shaft bearing is relieved, and the plant takes up the least possible amount of space.

The generators are running street railways and the arc machines street circuits.

The station illustrated is at (Farmers) Attleboro, Mass., and is owned by the North Attleboro Steam & Electric Co. They have also a station at North Attleboro, Mass., and will move some of their dynamos from North Attleboro to this new station this summer. The engine was installed by Messrs. John Post, Jr., & Co., and is a compound condensing Ide engine. Mr. H. M. Dagget, Jr., is manager of the company, and expresses himself as being highly satisfied with the efficiency of the entire plant.

Another field in which the Evans friction cone is being introduced is that of marine work. Few vessels have much spare room and hence anything effecting economy of space is welcome.



Light and Power Plant Driven by Evans Friction Cone Pulley.

THE PATTEE LAMP HOUR RECORDER.

The rapid strides which central station lighting for large areas has made of late years, have brought incandescent lamps into many places distant from the stations, the more so since the competition between the direct and alternating current systems of distribution has tended to stretch out the area supplied by each station. In this way many places which had not been able to install an isolated plant have been given the necessary luxury of incandescent lamps. The usual basis of charge for the current supplied has been the number of lamp hours at the consumer's place, *i.e.*, the number of lamps multiplied by the number of hours that they were burning. In many places, especially large business houses, where the lights are manipulated by gang switches, the lamps controlled by each switch are all turned on or off together. Then it is only necessary to keep count of the number of hours they were burning in order to compute the charges.

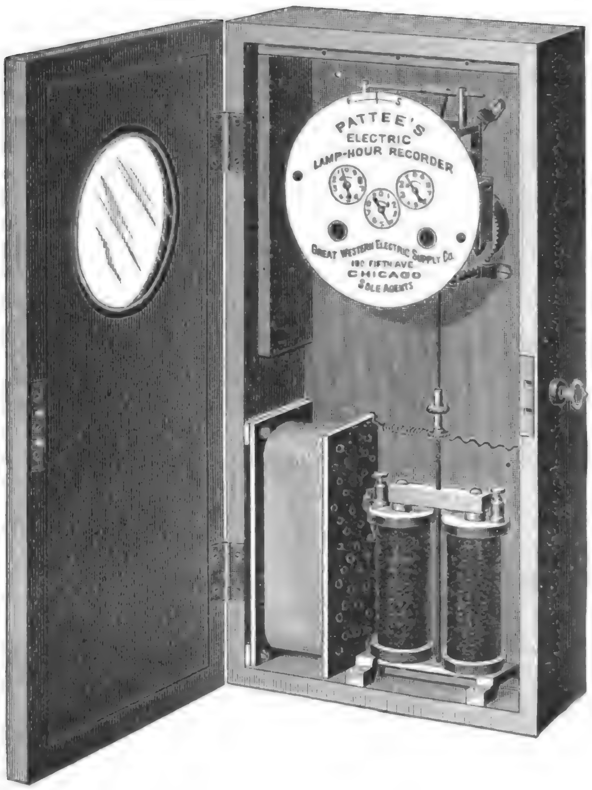
The meters in general use will give the number of hours only indirectly, hence the need of a simple and reliable counter for use with incandescent lamps has long been felt. This want is met by Pattee's electric lamp recorder, an instrument now being brought out by the Great Western Electric Supply Company, of Chicago. The cut (page 10) shows it with the door to the enclosing case opened. A clock-work with two powerful springs intended to run the recorder 720 hours, has three dials registering the hours, tens and hundreds. The inverted horse-shoe magnet, mounted on a brass plate below the clock, has its coils connected in series with the german silver resistance shown right beside it, the whole being connected in shunt with the lamps. The armature of the magnet is hung from a slender rod, and by its weight acts through a bell-crank lever as a brake to the escapement-wheel of the clock. When the current to the lamps is turned on, the armature is drawn up, and, acting on the lever and brake, at once releases and starts the escapement. As soon as the current is stopped, whether by the switch near by or by the shutting down of the station, the armature falls and stops the clock.

Thus the clock only runs while the lamps are burning, and the dial readings give the number of hours directly.

The whole apparatus is well built, and seems to have nothing about it which could get out of order. The german silver wire is wound on a bobbin with perforated heads, and has air spaces between the layers. The turnbuckle shown in the middle of the rod to which the armature is fastened, serves to adjust the play of the armature and its distance from the magnet poles. The lever, slide and brake are very neatly arranged, giving a positive start to the escapement and stopping it instantaneously.

The recorder is mounted in a walnut case like a clock, the dial being visible through a glass plate. A clock assures the current supplier that the instrument is not being tampered with, while the direct reading dial should give the consumer confidence in the correctness of the readings.

As ordinarily built, the coils have such a resistance that on a 110 volt circuit, the energy consumed is only 10 watts. By suitably varying the resistance, the Pattee recorder



THE PATTEE LAMP HOUR RECORDER.

can be adapted to currents of any pressure. Moreover it can be adapted for use with multiple, series, series-multiple or multiple-series lines and also alternating currents. There is no mystery or uncertainty about its operation.

POWER STATION, CITIZENS' STREET RAILWAY, INDIANAPOLIS.

THE Power Station for the Citizens' Street Railway Company at Indianapolis, Ind., is a handsome brick structure, as represented in Figs. 1 and 2 on the adjoining page. It is of sufficient capacity to contain 23 Thomson-Houston railway generators, and at the same time provide office room and a general machine shop.

The boiler plant consists of 3 Hazelton boilers, fitted to burn natural gas, and also arranged with furnaces to burn coal, as shown by the 3 extensions to each boiler on the plan. The gas burners in each boiler are located in such a manner that they do not interfere in the slightest with the coal furnaces, it being possible to make a change from gas to coal at a moment's notice. This is a very great advantage over the ordinary practice, as it is customary to place these burners on the grates, which, in case it was desired to use coal, would have to be removed, a by no means easy task.

The engines are so arranged and connected that any number can be run at the same time, and any one can be started and stopped while the remainder of the plant is in operation. The shafting is made of the best quality hammered steel and is supported by ball and socket self-oiling bearings. This is the first system that has been equipped upon this plan, and it is highly satisfactory. The steam piping for this plant is of ample capacity and so arranged that when the whole plant is in operation every detail will be of proper size and proportion.

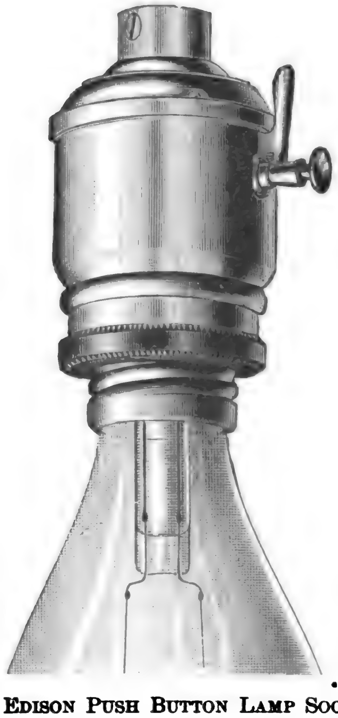
The feed water for the boilers is first passed through a Hoppes purifier which removes the impurities and heats the water at the same time up to boiling point. From this heater the water is pumped by Barr duplex pumps into the boilers. Everything about the feed water system is arranged in duplicate so that in case of accidental injury, operations would in no way be interfered with.

The general arrangement of this installation is shown by the cut representing a section across the engine and dynamo room. The entire installation rests upon masonry, consisting of a concrete base with the brick work on top laid in cement, and everything about the plant is constructed in the most substantial manner possible, and its operation is ample proof of the thorough workmanship and good material employed.

The engine, which has just been put in operation, was built by the Wheelock Company, of Worcester, Mass. The entire installation was planned and erected by Mr. L. H. McIntire of the Railway Engineering Department of the Thomson-Houston Electric Company. The work of installing the plant was in charge of Mr. W. S. Twining.

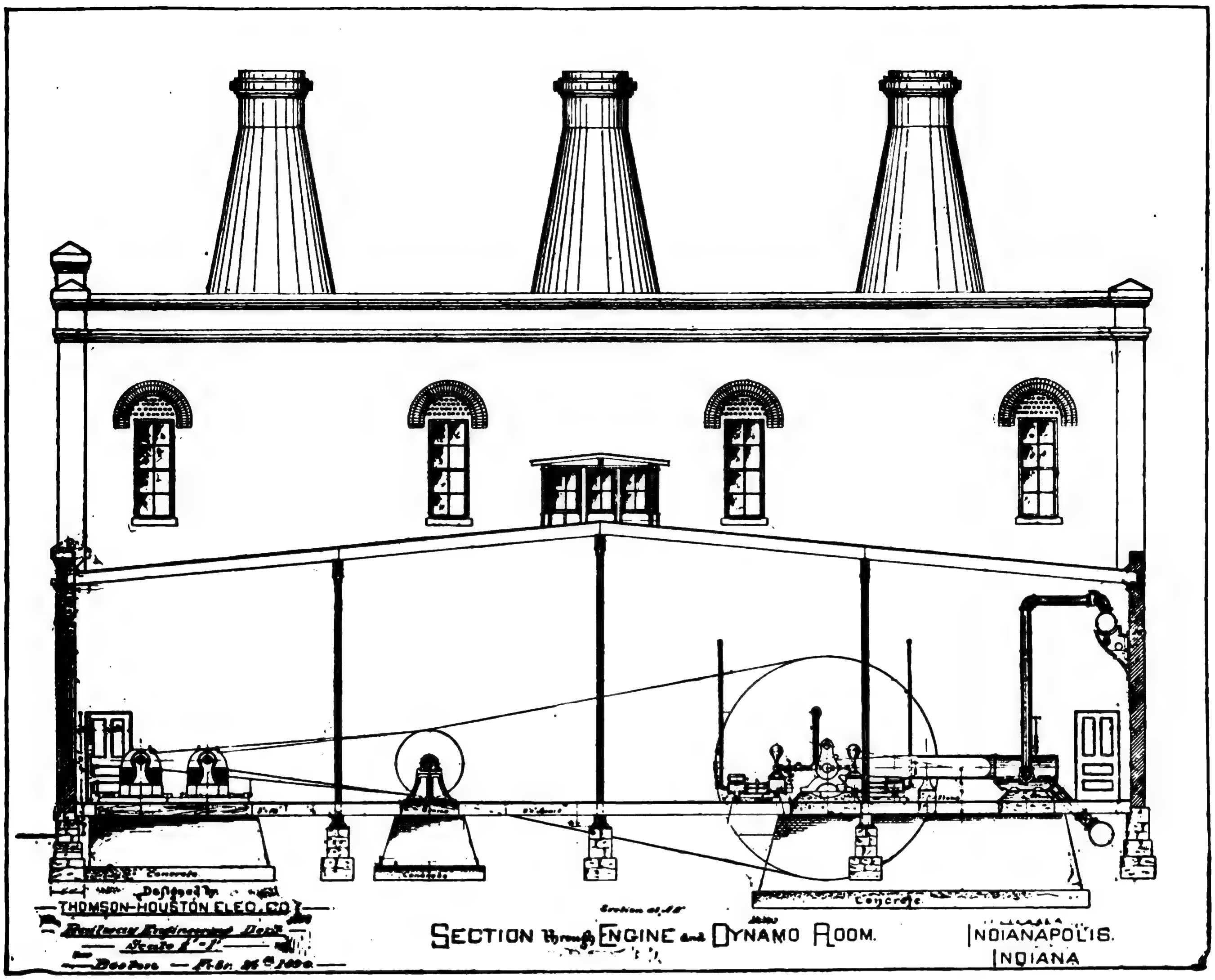
NEW EDISON LAMP AND PUSH BUTTON SOCKET.

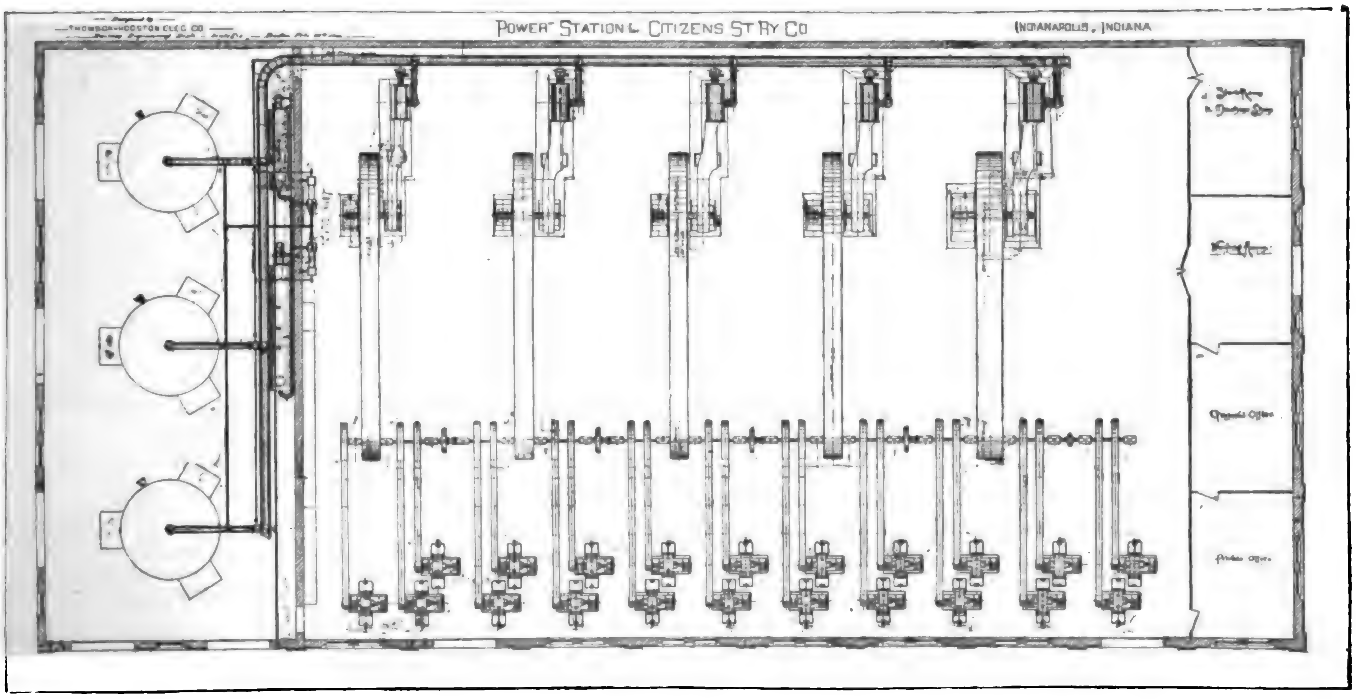
THE usual form of switch employed on incandescent lamps is so constructed that when the lamps are used as drop lights suspended from flexible cords, or attached to flexible fixtures, it requires the use of both hands to light or extinguish the lamp. In order to avoid this inconvenience and to permit of the easy lighting and extinguishing of the lamp, the United Edison Mfg. Co. have recently



NEW EDISON PUSH BUTTON LAMP SOCKET.

brought out the switch socket illustrated in the accompanying engraving. As will be seen this consists of a push button which, when pressed, closes the switch, and is maintained in position by a spring-latch, provided with a short lever extension. By pressing the latter the push is released and a spring forces the button out, thus opening the switch. By the use of but one hand, therefore, both operations can be conveniently performed.





FIGS. 1 AND 2.—ELECTRIC POWER STATION, CITIZENS' STREET RAILWAY, INDIANAPOLIS.

SOME EXPERIMENTS UPON ALTERNATING CURRENT APPARATUS.[1]

BY HARRIS J. RYAN.

It is well known that when the core of a transformer is heated under certain favorable conditions the secondary will deliver electrical energy in amount considerably greater than when the core is not heated, and that this is done, too, without an increase of energy that is supplied to the primary. In fact, we are told that on heating the core of the properly constructed transformer, there will be obtained a diminution of energy taken up by the primary, and a considerable increase in that given out by the secondary.

In some recent experiments made in the Physical Laboratory of Cornell University it was not possible to obtain the above effect. Mr. L. B. Marks, a student in electrical engineering at Cornell, made an apparatus that differed materially from the

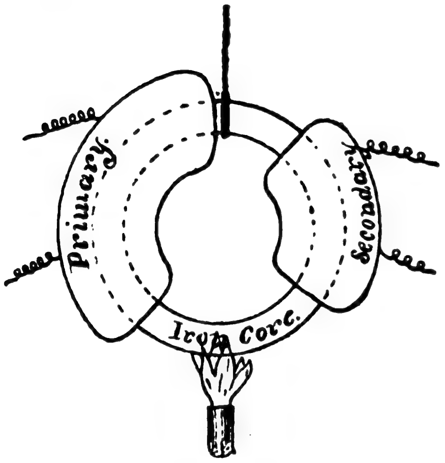


Fig. 1.

forms that were first made use of, in which he found this phenomenon very marked.

For two reasons we think that the details of the performance of Mr. Marks' apparatus to be of interest to the members of the Institute. First, that they indicate clearly the source of energy in the phenomenon observed with his apparatus, and, second, that they show in exaggerated form certain phenomena that must be done away with in a transformer that is to be used for incandescent lighting.

A good idea of the apparatus will be obtained by a glance at Fig. 1. The core consisted of well rusted wire rings 1.1 cm. thick, and of a mean diameter of 17 cms. each. The number of turns on the primary was 500 and on the secondary 155. The size of

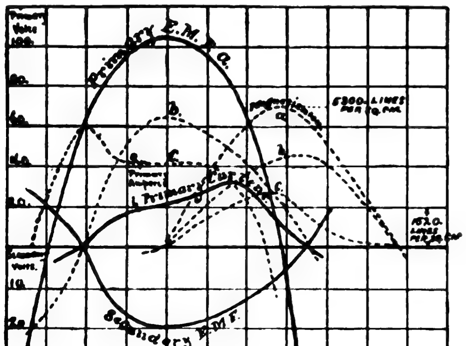


Fig. 2.

bare copper wire in each was No. 18 B. & S. G. The wire was insulated with asbestos paper, and because of its thickness the primary and secondary turns with their insulation occupied a space of abnormal proportions.

Resistance of the primary.............. 1.65 ohm.
" " " secondary........... 0.71 "

The maximum magnetization used in the core in any of the experiments here described was not above 3,000 lines per sq. cm.

1. A Paper read before the American Institute of Electrical Engineers, June 17, 1890.

The diagrams, Figs. 2, 4, 5 and 6 represent graphically the observations that were made with the apparatus. From these diagrams are deduced the following results:

SECONDARY OPEN. NO EXTRANEOUS HEAT APPLIED.

Temperature of the core........... .... 97.5° C.
Primary E. M. F.......................... 75.6 volts.
Secondary E. M. F........................ 16.4 "
Ratio $\frac{75.6}{16.4}$.............................. 4.6
Secondary current.......... .... 0.0

SECONDARY OPEN. CORE HEATED.

Temperature of core.......................... 300° C.
Primary E. M. F .... 99.4 volts.
Secondary E. M. F......................... 24.5 "
Ratio $\frac{99.4}{20.5}$.............................. 4.
Secondary current.......................... 0.0

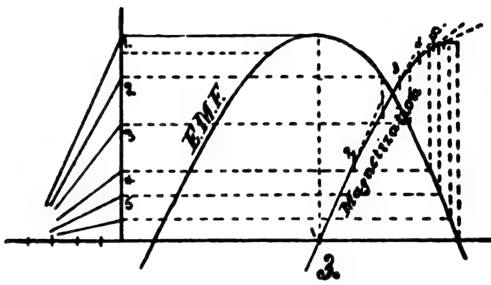


Fig. 3.

SECONDARY CLOSED. HEAT APPLIED.

Temperature of the core .... 100° C.
Primary E. M. F... .... 89.3 volts.
Secondary E. M. F.................... 11.9 "
Ratio $\frac{89.3}{11.9}$....................... 8.1
Secondary current.................. 2.0 amperes.

SECONDARY CLOSED. CORE HEATED.

Temperature of core................ 270° C.
Primary E. M. F..................... 95.7 volts.
Secondary E. M. F.................... 13.4 "
Ratio $\frac{95.7}{13.4}$ 7.1
Secondary current................. 2.4

TABLE I.

	Temp.	Primary E. M. F.	Primary Watts.	Secondary Watts.
2. Secondary open, no heat applied to core....	97.5° C.	75.6	87.	0.0
4. Secondary open, heat applied to core.........	300° C.	99.4	88.	0.0
5. Secondary closed, no heat applied to core....	100° C.	89.3	139.	24.
6. Secondary closed, heat applied to core.........	270° C.	95.7	129.	36.7

TABLE II.

Temp.	Loss in Core.	Primary Watts.	Secondary Watts.	
2. 97.5° C.	122	122	0.0	
4. 300° C.	72.	72	0.0	
270° C.	79 (Estim.)	79	0.0	Corrected for rests of sec.
5. 99° C.	117	131	24	
6. 270° C.	80	116.7	36.7	

Primary, 90 volts; 120 reversals per second.

Data are presented in the latter part of this paper showing that it is correct to assume for small ranges that the loss in the core is proportional to the square of the primary E. M. F. We can therefore deduce from Table I the results that would have been obtained with 90, volts as the primary E. M. F. for the four experiments.

The figures in Table II show clearly that the loss in the core is greatly diminished when its temperature is elevated, *i. e.*, when heat is applied, and that the loss in the core is practically independent of the output. The results indicate that with the secondary open, and the primary at a difference of potential of 90 volts without heat applied, the core came to a temperature of 97°C., and dissipated 122 watts; then by the application of heat with the Bunsen burner, as indicated in Fig. 1, the temperature of the core was raised to 300°C., and was found to take up 72 watts. Now, if we assume the changes in watts dissipated in the core to be ap-

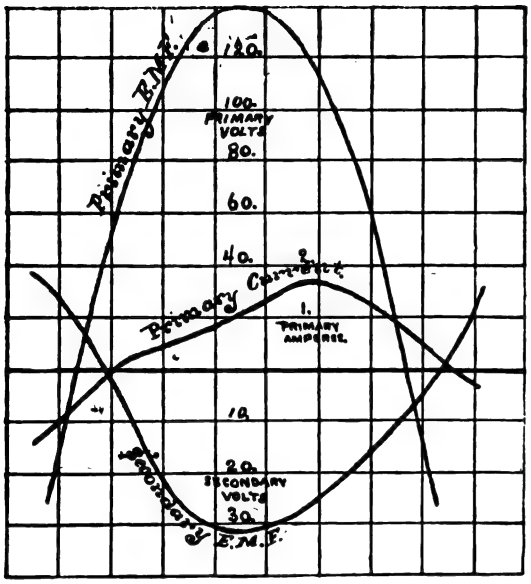


Fig. 4.

proximately proportional to the changes in temperature that produced the same, then we see by estimation that 79 watts would have been dissipated by the core at 270°C., while 80 watts were found to have been dissipated by it at that temperature when the secondary was closed and gave an output of 32 watts.

It is perfectly plain, therefore, why we can close the secondary, take from it 32 watts, elevate the temperature of the core 170°C., and have the primary take up 5 watts less than when the secondary was open, and the core at the lower temperature.

Since the effect is due only to the fact that the core takes up

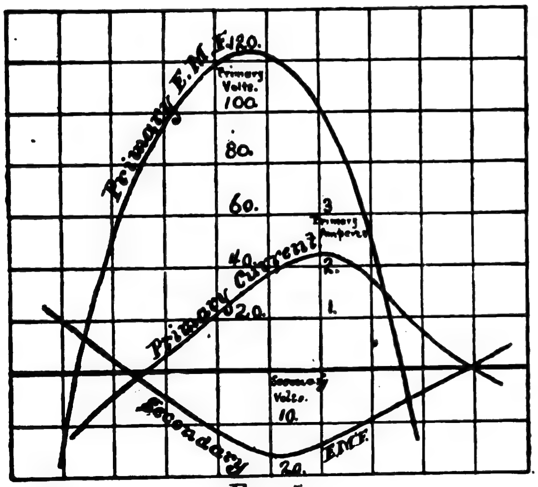


Fig. 5.

much less energy at higher than at lower temperature, and since the core can dissipate energy through *Foucault current* and *hysteresis* phenomena only, it is due to a decrease of the total energy dissipated through changes in the above phenomena.

A rise of temperature in the core will increase its specific resistance, and therefore diminish the energy dissipated by Foucault currents. For decided degrees of magnetism it is known that the permeability of iron increases when it undergoes a rise of temperature. It was thought probable, therefore, that the energy dissipated per cycle of magnetization and demagnetization would be decreased with an increase of temperature.

Experiments were made in the Physical Laboratory of Cornell University by Mr. Arthur Herschel on the hysteresis at high temperature of a cast iron ring, 12.3 cms. in diameter, that furnished a closed magnetic circuit, the length of which was 38.5 cms. The ring was wound with 80 turns of No. 8 wire cable that had a mica insulation. The highest temperature to which the ring was subjected was 360°C. The results of these experiments are represented graphically in Fig. 7.

One interesting thing about these results is that for degrees of magnetization below 2,000 lines per sq. cm., the variation of temperature below 360°C. does not change the magnetic character of the iron by an observable amount. Now, if wrought iron behaves in a similar manner then the decrease of energy dissipated

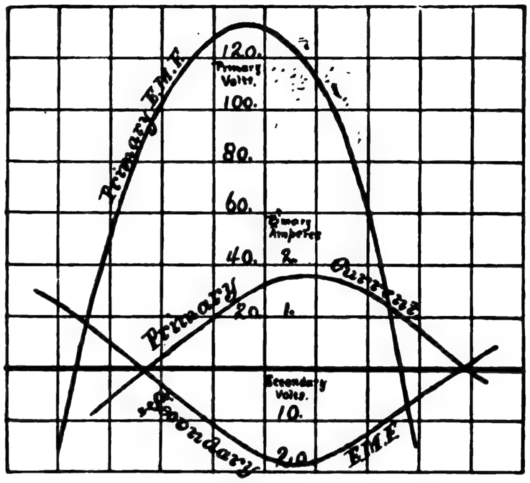


Fig. 6.

in the apparatus of Mr. Marks was not due wholly, nor in part, to a diminution in the hysteresis of the iron. It was, therefore, due entirely to the diminution in Foucault currents, caused by the change of the resistance of the iron. A liberal estimate for the hysteresis of the core is 20 watts, whence the Foucault energy dissipated by the core at 100°C. and 90 volts was 102 watts, and at 270°C. and 90 volts it was 60 watts.

The range of temperature that produced this change was 170°C. The magnetization for each condition is the same, so that it is fair to assume that the E. M. F. setting up the Foucault currents is the same, and that, therefore, the energy dissipated by Foucault cur-

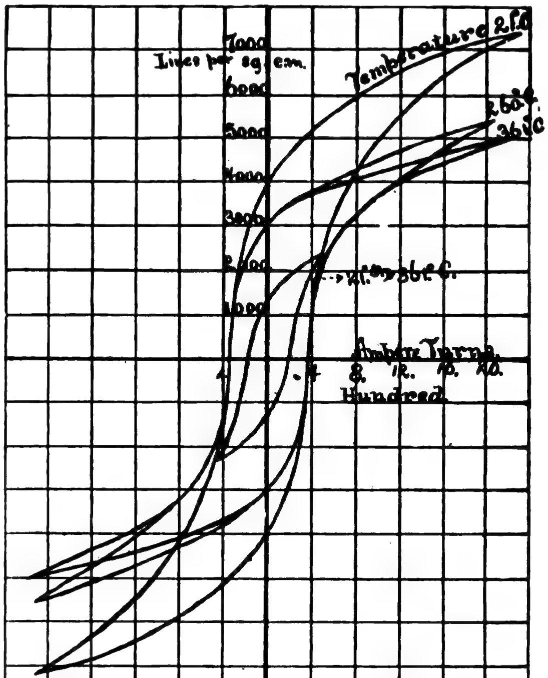


Fig. 7.

rents will diminish as the resistance of the iron is increased by the elevation of its temperature. This gives us a rough determination for the temperature coefficient of the iron to .4 of 1 per cent. per degree centigrade, which agrees with Matthiessen's determination and furnishes a fair check upon the conclusion just arrived at.

The second interesting feature about the performance of Mr. Marks' apparatus lies in the fact that the ratio of primary to sec-

ondary turns was 3.2, while the ratio of primary to secondary E. M. F. varied from 4 to 8. In this it exhibited exceedingly bad regulation, so that by examination of the diagrams, Figs. 2, 4, 5 and 6, we can see in exaggerated form the trouble it is so hard to get rid of in transformers to be used for incandescent lighting. Any one of these diagrams shows that a large portion of the lines of magnetization that was set up about the primary were not set up about the secondary. That is to say, the counter E. M. F. that

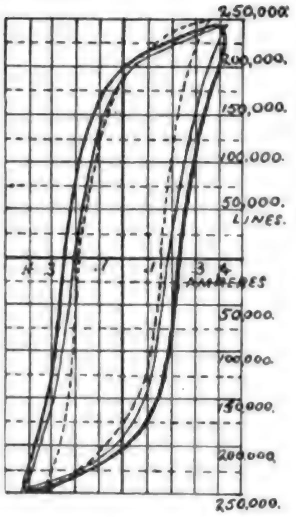


FIG. 8.

is produced in the primary is due to the magnetization through it that also took place through the secondary, plus the variation of magnetization that was set up in its own air space, and that leaked by the secondary through the air. When the transformer furnishes current this difference becomes greater and greater because of the increased current in the primary, and the setting up of a counter-magnetization by the secondary current in its own air space that still further reduces the magnetization through it.

Fig. 1 shows the primary disposed on one side and the secondary on the other side of the annular core. The insulation was

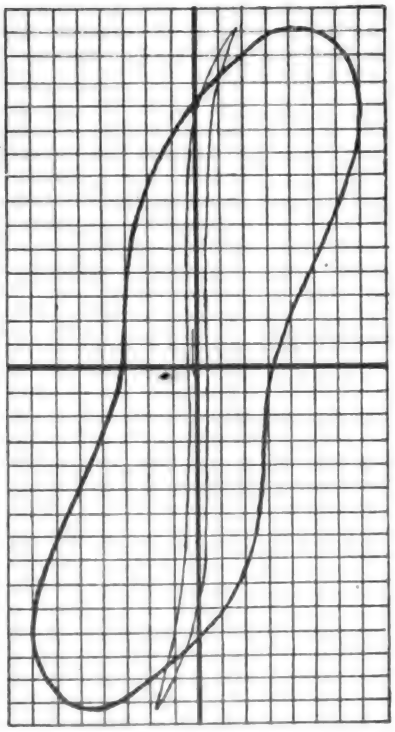


FIG. 9

produced by thick asbestos paper that produced large air spaces between the turns in which magnetization was produced.

In Fig. 2 E. M. F. curve b is the counter E. M. F. in the primary produced by the magnetization through it that also took place through the secondary, and which is obtained by multiplying the secondary E. M. F. by 3.2, the ratio of the turns. E. M. F. c. is the curve of counter E. M. F. in the primary that was produced by magnetization through the primary that did not take place through the secondary. This is obtained by subtracting E. M. F. b from E. M. F. a. E. M. F. c. is seen to be approximately proportional to the rate of change of the primary current, which suggests magnetization that is set up through the primary that is proportional to the primary current, or that which is set up in the air, or, in a magnetic circuit compounded of iron and air.

In the same figure the curves of magnetization a and b are obtained graphically from the curves of E. M. F. a and b by the method shown in Fig. 3. This method is found to be fully as accurate and requires much less time and is more simplified than the analytic method making use of Fourier's theorem.

By substracting b from a we obtain c, the curve of magnetization that was produced through the primary and not through the secondary. This curve of magnetization c is seen by the diagram to be of about the same form as the current curve, but to lag behind the latter, which indicates that it was magnetization that was produced through air and air and iron.

During the discussion, at a recent meeting of the Institute, the question was asked whether measurements of Foucault currents

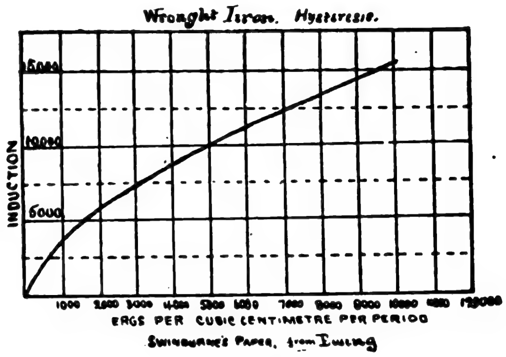


FIG. 10.

and hysteresis as separated from each other had ever been made.

There can be no doubt but that we do have separate determinations of those quantities when we have determined the energy dissipated in a magnetic circuit of iron by rapid cycles of magnetization and demagnetization, and the energy dissipated by static hysteresis for the same rapidity and degree of magnetic changes as determined from a Ewing card observed through slow magnetization and demagnetization.

The diagrams Figs. 8 and 9 are two good illustrations of such determinations. In Fig. 8 the outer card represents the card ob-

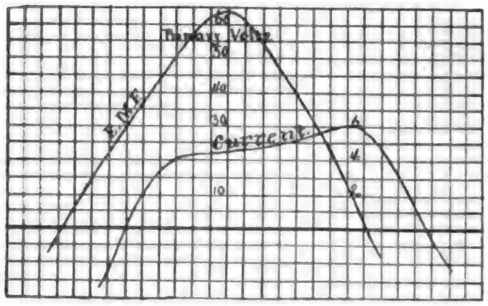


FIG. 11.

tained from the exciting current and magnetization curves taken carefully at 138 reversals per second from the ten-light transformers upon which the tests were made, that were communicated to the Institute by the writer at the last December meeting. The inner card drawn in a full line in Fig. 8 is the Ewing card of static hysteresis. This transformer, on being taken apart, was found to have its discs insulated with paper, so that the statement made by the writer in December with regard to the lamination of this transformer was erroneous in this particular. Foucault currents should therefore be found to be quite absent, as the diagram in Fig. 8 indicates. A study of these cards does not reveal that which can be recognized as a trace of viscous hysteresis, and they differ only by an amount of Foucault current energy that is represented by a small current lagging approximately an eighth of a period behind the primary impressed E. M. F.

In Fig. 9, the outer card is deduced from the current and magnetization curves that are represented in Fig. 12. These curves were obtained with 195 reversals per second from a cast iron ring 8.6 cms. in diameter, and 2.7 sq. cms. in cross-section, wound with 200 turns of wire that had a negligible resistance.

In Fig. 9. the inner card is the card of static hysteresis. In Fig. 12, the lower broken current curve is that of the exciting

current curve drawn in from the inner card of Fig. 9. By subtracting this current from the one that was observed, we obtain the upper broken current curve, which is the current that exists

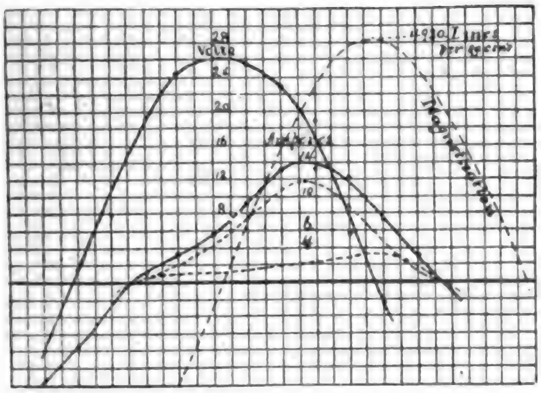


FIG. 12.

to supply the Foucault current energy in the core. The point to be noticed from the two extreme cases here taken up is, that in each case the curve of current supplying the Foucault current

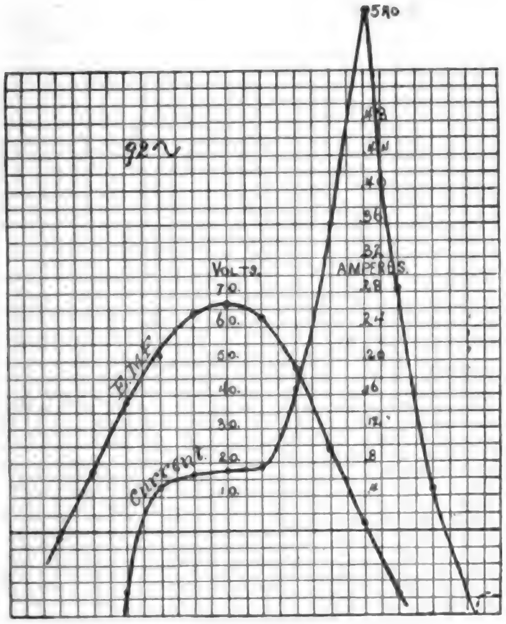


FIG. 13.

energy is about one-eighth of a period behind the impressed E. M. F. Messrs. Forhenbaugh and Sawyer, students in electrical engineering at Cornell University, made determinations, the results

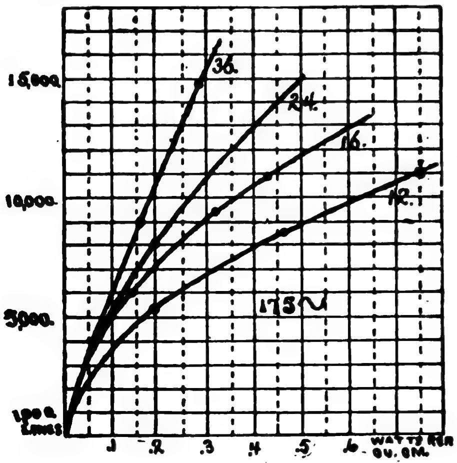


FIG. 14.

of which are given in Table III, of the amounts of energy that are taken up per cubic cm. in wrought iron wire cores of different degrees of lamination, at various degrees of magnetization, and at different periodicities, in which the oxydized surface of the iron was depended upon for insulation. They made use of four iron wire rings the mean diameter of each of which was 8.9 cms. and on each of which are wound 200 turns of wire that had a negligible resistance. Figs. 11 and 13 are given for illustrating the extreme variation in the character of the exciting current in going from the lowest to the highest degree of magnetization.

The result shows, on account of the presence of Foucault currents to a larger extent for the higher degrees of magnetization, a variation in losses as the square of the periodicity and the square of the magnetization. The results obtained with the several cores at the periodicity of 175 reversals per second have been plotted in Fig. 14.

TABLE III.

Coil. No. of wire B. and S. G.	Area of coil, sq. cms.	Periodicity.	Magnetization per sq. cm.	Loss watts per cu. cm.
12	5	169	5,300	.18
“	“	177	8,560	.46
“	“	177	11,130	.75
16	4.9	173	6,000	.14
“	“	175	9,430	.33
“	“	167	10,930	.43
“	“	93	7,250	.10
“	“	92	13,360	.41
“	“	45	13,000	.10
24	3.56	175	8,150	.19
“	“	53	8,760	.12
36	3.14	173	9,200	.16
“	“	173	14,900	.29
“	“	173	18,000 app.	.48
“	“	96	10,700	.15
“	“	92	17,800	.33
“	“	47	18,000 app.	.13
“ Cast Iron	2.7	160	4,920	1.50

Diam. 3.5 × 2.54.

The card of No. 36 wire agrees closely with Ewing's determination of static hysteresis for moderately soft wrought iron, and is therefore entirely free from Foucault currents. It is interesting to note that for the cores of No. 36, No. 24, and No. 16, there is but little difference in the losses for degrees of magnetization below 4000 lines per sq. centimetre.

Likewise, for the higher degrees of magnetization, it is seen that the loss is proportional to the magnetization, as Ewing's results on static hysteresis, given in Fig. 10, indicate they should be. Fig. 13 shows the effect of compelling the magnetization to be carried above the bend of the characteristic curve of the iron.

ELECTRIC RAILROADS FOR THE SOUTH.

Street railroads in Georgia appear to be a good investment, says the *Baltimore Manufacturers' Record.* Not long ago some capitalists from Kansas City, Mo., headed by Mr. S. M. Jarvis, of the Jarvis-Conklin Mortgage Trust Co., which has headquarters in that city, and Mr. D. B. Dyer, purchased the Augusta Street Railway and immediately began to make preparations to convert it into an electrical line. They are now pushing work very rapidly, and Augusta bids fair to have as complete a street railroad system as any city of her size in the South. The Augusta & Summerville Railroad has also decided to adopt electricity as a motive power. This will give Augusta some 25 miles or more of electrical railroad. Savannah is just now the scene of a large street railroad deal. Nashville parties, among whom are I. T. Rhea and T. W. Wrenne, the latter being interested in a street railroad in St. Augustine, Fla., have purchased a considerable amount of street railway property in the "City by the Sea." It is not known definitely just what these men propose doing with their new acquisition, but it is supposed that they will convert it into an electrical line in about the same manner as has been done in Augusta. These same Nashville capitalists are rumored to have made large purchases of street railway property in Charleston, S. C.

A GERMAN ELECTRIC TARGET.

An electric target is one of the latest German ordnance inventions. It consists essentially of two parts, one the target itself and the other the electric registering apparatus. The target is made in sections. When struck by a bullet the particular section hit is forced back, together with its spring, by the force of the impact. The spring strikes a vertical lever and causes it to fall into a horizontal position. By this means electrical communication is established through contacts and a battery with the registering apparatus placed at the firing point, and an electric bell is rung simultaneously. To interrupt the circuit and stop the bell a cord is pulled and a brush passes over the face of the target, removing the bullet mark. At the same time the lever is restored to its original position.

EFFICIENCY OF THE TRANSFORMER.[1]

BY CALVIN HUMPHREY AND WILLIAM H. POWELL.

In pursuing this particular line of investigation it has been our endeavor to throw some light, if possible, upon the general subject of transformers and upon the action of iron when magnetized and demagnetized by an alternating current of high periodicity. And in order that the results obtained might have a practical bearing, the conditions of working were made to conform as closely as possible to the conditions under which transformer systems are operated in this country.

The question of the economy of the commercial converter as a transformer of energy has been frequently taken up, both from practical and theoretical standpoints, but with widely varying and conflicting results. The losses in the transformer of the closed circuit type have been considered large and inevitable, so much so, in fact, that Mr. Swinburne has introduced in England a new form of open circuit transformer known as the "hedgehog." It has been Mr. Swinburne's endeavor to obviate the dissipation of energy in hysteresis and Foucault currents in a part of the magnetic circuit, by having that circuit closed through air. But as will be seen later, the perfection of the transformer is to be met in a better grade or iron, rather than in any radical change in design.

The results presented in this paper are of especial interest as being supplementary to the work of Prof. Ryan and Mr. Merritt in the same line, which was presented to the Institute last December. The 10-light transformer which they tested was found to have a remarkably heavy loss on open circuit, which was shown to be due almost entirely to hysteresis in the iron. The transformer gave an efficiency of 86% at normal load and an "all-day" efficiency of about 40%.

In our work on a 40-light transformer of the same design,—the two coils placed side by side in a core of laminated plates, Fig. 1,—but of more recent manufacture, the loss on open circuit was found to be about one half as great as in the 10-light transformer. Its efficiency reached 96.2% at normal load, and the "all-day" efficiency would be about 90%.

The method employed in the work is substantially Prof. Ryan's method. The instantaneous values were obtained by means of a commutating device attached to the alternator. This device consisted of a wooden disc, mounted rigidly on the shaft of the alternator, with a steel contact at one point in its periphery, which made contact with a small piano wire brush once every revolution. The holder carrying the piano wire brush was attached to a second wooden disc carrying a pointer which moved over a scale and indicated the position of the brush for a given reading. By means of a clamp screw this second wooden disc carrying the brush and pointer could be conveniently set at any point. Now since the steel contact in the wooden disc is fixed relatively to the armature, it must share the ever varying E. M. F. of the armature. Then evidently if the brush which completes the circuit through the contact be altered in position, values can be obtained for different points on the curves of E. M. F. and current.

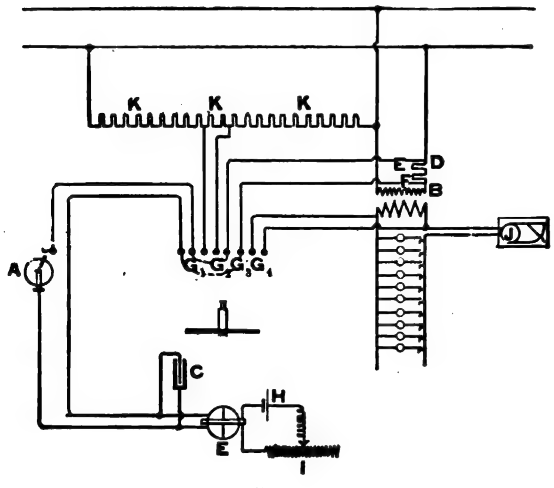
The Ryan quadrant electrometer was used to measure the primary E. M. F., secondary E. M. F. and primary current. A condenser was connected in multiple with the electrometer. The primary current was measured by the fall of potential through incandescent lamps placed in series with the primary of the transformer. These lamps were carefully calibrated with the standard instruments of the laboratory in order to know their resistance at different temperatures. Then knowing the resistance of the lamps, and the potential difference at their terminals, the current flowing at once becomes known.

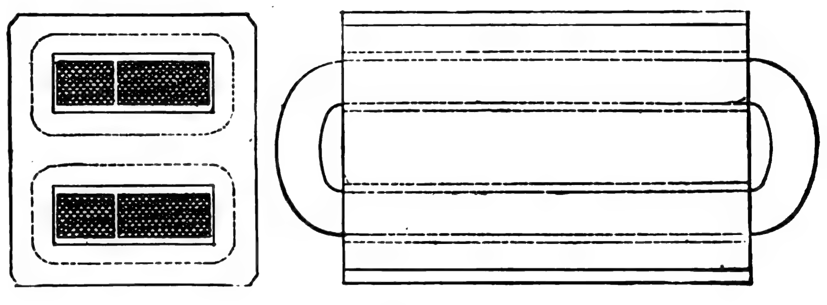
To measure the E. M. F., twenty-two 50-volt lamps were placed in series across the primaries. The electrometer was connected around two of these lamps, and the whole number calibrated in order to know just what part of the total impressed E. M. F. was measured. The secondary E. M. F. was measured direct. The secondary current was measured by means of an electro-dynamometer, which was carefully calibrated both before and after the experiments and was found to be constant. The commutating device was placed in series with the electrometer. Wires were run from the terminals from which the measurements were desired to a convenient switch-board.

In obtaining the Ewing card of hysteresis of the iron core of the transformer, current from a storage battery was sent through the secondary circuit, and the magnetization set up in the core was measured by the "kick" on a ballistic galvanometer in the primary circuit. The current in the secondary was gradually increased until the intensity of magnetization corresponded with the maximum magnetic density of the transformer when working on a 100-volt circuit. The current was then decreased, gradually, until zero was reached. It was then reversed and the method continued until a complete cycle of magnetization had been covered.

It is worthy of mention that this method which gives something so definite and fundamental in the treatment of the alternating current has only come into use within the past year, and the task of getting true instantaneous values of the complete waves of E. M. F. and current which has always been considered too tedious for ordinary patience to deal with was accomplished with ease in this work in forty-five minutes. A calibrated scale for the electrometer readings added very much to the facility with which observations could be taken.

The marked improvement of the 40-light transformer over the 10-light is due, we believe, to an improvement in the magnetic properties of the iron and a fewer number of turns in the coils, made possible by the better grade of iron. In the 10-light transformer Foucault currents were very effectually weeded out by the interposition of sheets of paper between the laminated sheets of iron; in the 40-light, the oxide of iron on the surface of the plates was the only safeguard against Foucault currents.





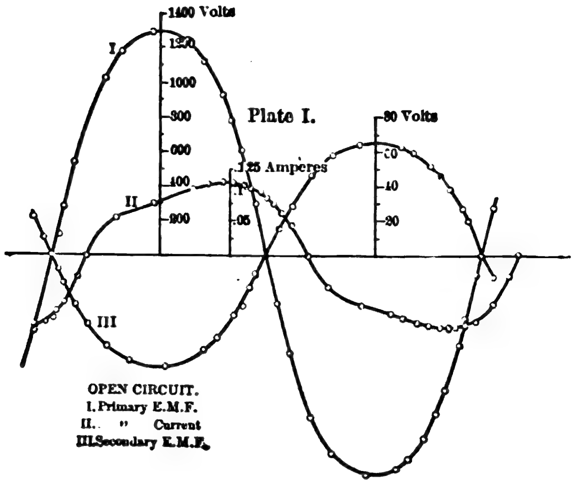
Figs. 1 and 2.—Humphrey & Powell on the Efficiency of the Transformer.

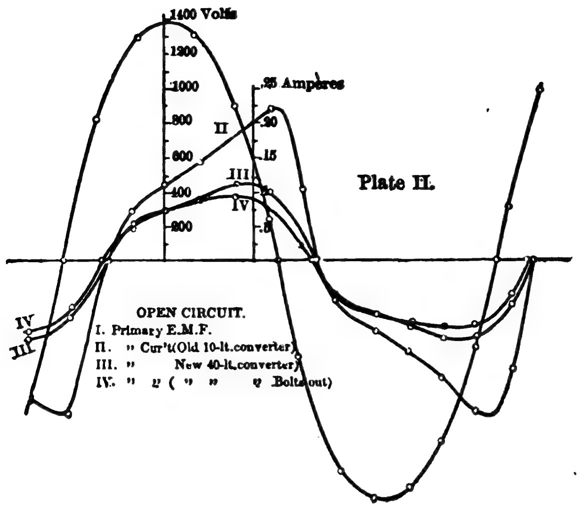
The form and extent of the open circuit curves show the loss due to hysteresis and the slight loss also due to the Foucault currents. The presence of Foucault currents is indicated by the fact that the maximum of the primary current wave does not occur simultaneously with the zero of primary E. M F., but a little before. It is found upon analysis of the primary current curve into its elements, hysteresis and Foucault currents, (see plate XIII.), that the Foucault current component occurs 120° in advance of the theoretical magnetization curve, and not 90° in advance, as has generally been assumed. Therefore, when superimposed upon the hysteresis curve, it introduces a component in advance and thereby decreases the lag of the primary current.

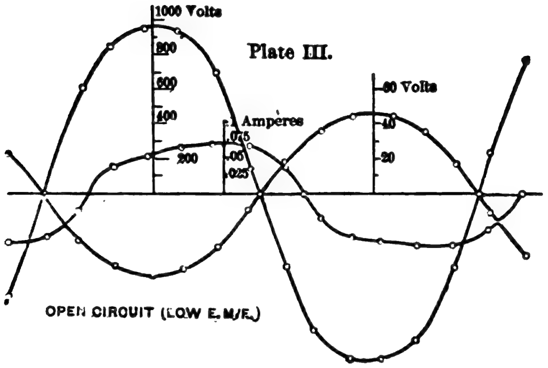
The primary current curve was again taken with the laminated plates loose and free to vibrate. The loss was about 10% less than in the former case (Plate II.) This is thought to be brought about by the decrease in the hysteresis loss, due to the increase of mechanical shock arising from the free vibration of the plates. The vibration was very perceptibly increased. The curve obtained is more regular in form indicating less hysteresis loss.

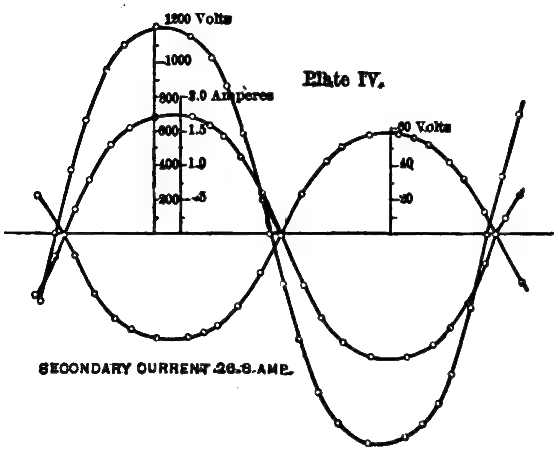
The lag of the primary current behind the primary E. M. F. is seen to be greatest when the secondary circuit was open and decreases as a non-inductive load is introduced into the secondary circuit. This tendency of the lag of the primary current to de-

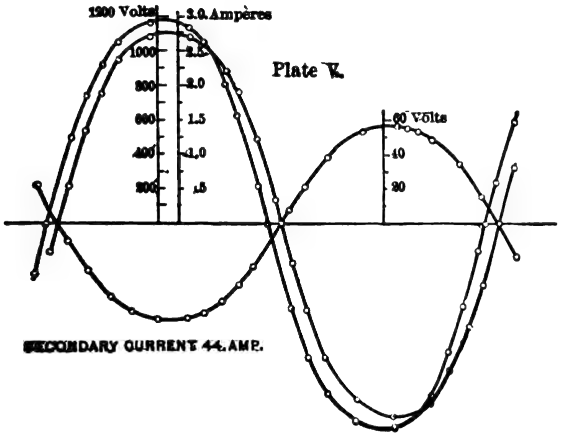
1. A paper read before the American Institute of Electrical Engineers, June 17, 1890.

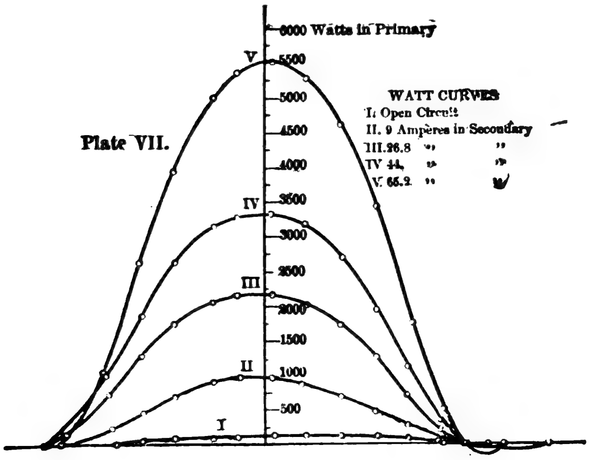


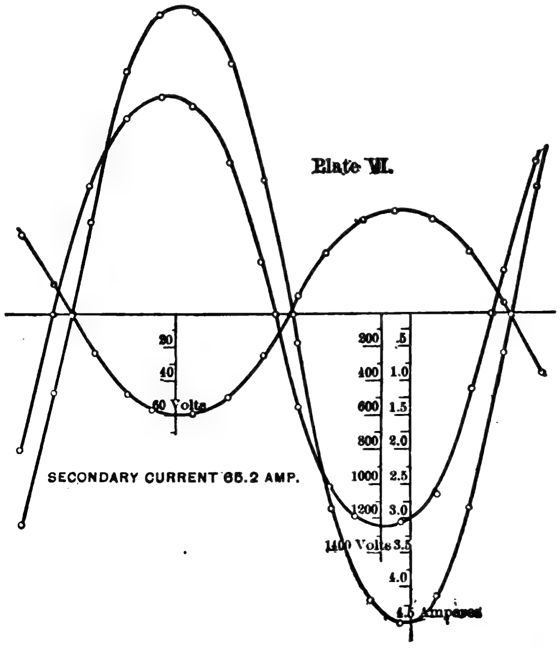












HUMPHREY AND POWELL ON TRANSFORMER EFFICIENCY.

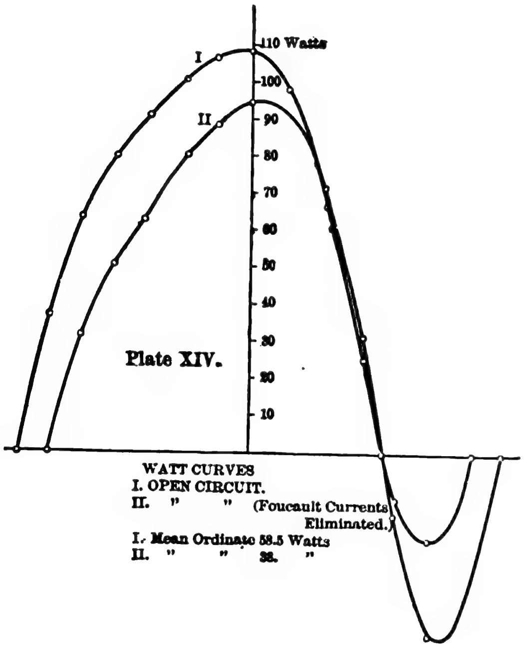
crease with increase of load, continues until the curve of primary current comes into unison with the curve of secondary E. M. F.

The secondary E. M. F. is in unison with the primary E. M. F. on open circuit and gradually falls behind as the load increases on the secondary. This is doubtless due to the leakage of lines of force arising from the enormous magnetizing forces at work in opposition to one another in the primary and secondary circuits.

When an inductive resistance is introduced into the secondary circuit, the lag of the primary current is greatly increased, as shown by the set of curves in Plate X. The inductive resistance used in this case was due to a small alternating current motor. The curve of secondary current was also taken and found to lag behind the secondary E. M. F. and to be in unison with the primary current. About 5.5 amperes flowed in the secondary and yet the lag of primary current is as great as on open circuit.

Plate XI shows the relation of primary current and primary E. M. F. when the secondary was closed through the secondary of a 20-light transformer whose primary remained open. The current curve shows a distinctive lag from the inductive resistance and is altered in form to a great extent.

The outside loop in Plate XII is the loop of total loss in hysteresis and Foucault currents, deduced from the open circuit curves in the following manner. The current which flows to maintain the counter E. M. F. of the transformer on open circuit obviously includes the losses due to Foucault currents and hysteresis. If then a megnetization curve whose maximum has been computed, be drawn in 90° behind the curve of primary E. M. F. and of the same form—since it is a function of the E. M. F.,—and a curve be plotted using ordinates of primary current as abscissae, and corresponding values of lines of force from the theoretical magnetization curve as ordinates, the outside loop in Plate XI is obtained.



The inside loop is the ordinary Ewing card of hysteresis loss found by carrying the iron slowly through a complete cycle of magnetization. The lines of force were computed from the "kick" on a ballistic galvanometer. This card has in it no Foucault current effects. If then we reverse the above method, and from the Ewing card and the magnetization curve deduce a primary current curve, we shall have a curve representing hysteresis loss for this iron. This was done, and it is of especial interest to note that the form of curve obtained in this manner is identical with the open circuit curve of the 10-light transformer in which Foucault currents were suppressed by the interposition of sheets of paper (see Curve III, Plate XIII.) Having then two curves plotted to the same scale, one representing total loss and the other hysteresis loss, if we subtract ordinates of the latter from corresponding ordinates of the former, a curve representing the component due to Foucault currents will be obtained (curve IV, Plate XIII.) It was in this manner that the analysis before referred to, was made. The position of the Foucault current component accounts for the round corners in the outside loop of Plate XII.

From Plate IX will be seen the watt curves for open circuit loss, one for 990 volts and the other for 740 volts. From the value of the mean ordinates it is seen that the loss varies strictly as the square of the impressed E. M. F.

In Plate II is plotted to the same scale the current which flowed on open circuit in the case of the 10-light transformer and the 40-light transformer.

Plates IV, V, and VI show the curves of primary E. M. F. and current and secondary E. M. F. for different loads, from which the watt curves of Plate VII. are computed by taking the product of corresponding ordinates of primary E. M. F. and current.

The efficiency curve shown in Plate VIII. is the ratio between the energy of the primary circuit as indicated by the mean ordinate of the watt curve, and the energy of the secondary circuit as expressed by the product of the $\sqrt{\text{mean}^2}$ readings for E. M. F. and the current. The coercive force is equal to .8 C. G. S.

These consideration go to show that the loss due to the reversal of polarity of the iron, which perhaps must always be present, may be reduced almost indefinitely by a proper study of the magnetic properties of the iron used.

The watt curves in Plate XIV show the relation between the total loss on open circuit and the loss if Foucault currents were eliminated.

ELECTRIC ADHESION DEMONSTRATED BEFORE THE RAILWAY MASTER MECHANICS.

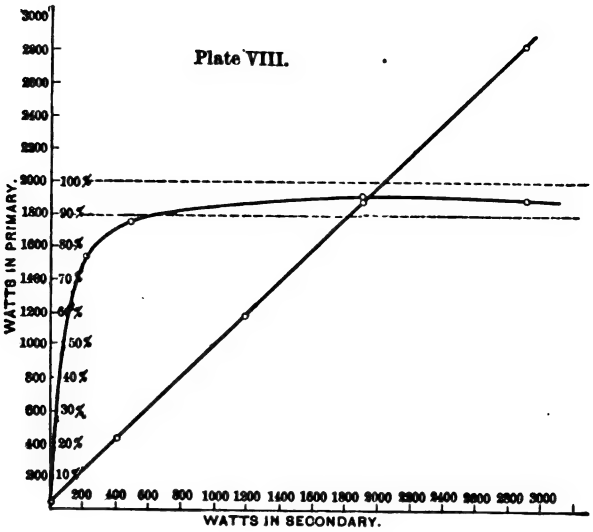
At the recent convention of the American Railway Master Mechanics' Association, held at the Hygeia Hotel, Old Point Comfort, Va., there was exhibited a small working model illustrating the operation of the Ries electric traction increasing system as applied to steam locomotives. This exhibit attracted considerable attention and was the occasion of no little astonishment among those of the master mechanics who hitherto believed that there was nothing to equal sand as a traction increaser. The passage of a low tension quantity current between the driving wheels and rails enabled the locomotive to readily ascend grades varying from 20 to 45 per cent. in steepness, whereas without this current the revolving driving wheels were unable to make any headway on grades considerably less severe than the one first mentioned. The pulling capacity of the locomotive on a level track was very greatly increased by the passage of the current, and it was also shown, much to the surprise of the expert master mechanics, that the increased tractive adhesion resulting therefrom was not diminished when the rails were wet or coated with oil. The remarkable efficiency of the traction increasing current as a braking agent was likewise exemplified by its promptness in arresting the momentum of the locomotive on a steep down grade while sliding rapidly from the top toward the bottom of the latter.

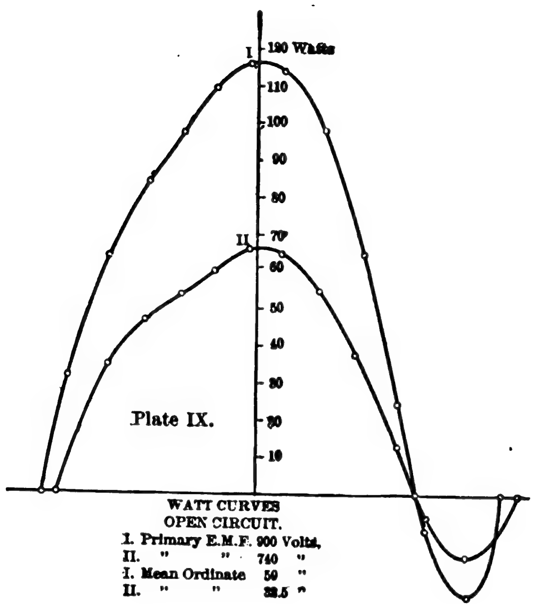
The performance of the apparatus was a revelation to those who witnessed it, and elicited much favorable comment. Drawings showing the application of the system to full sized locomotives were exhibited, and were critically examined. The apparatus was in charge of Mr. Elias E. Ries, who was kept busy in explaining its operation. The system has already been successfully applied to railway locomotives, and further experiments in this direction are now being made.

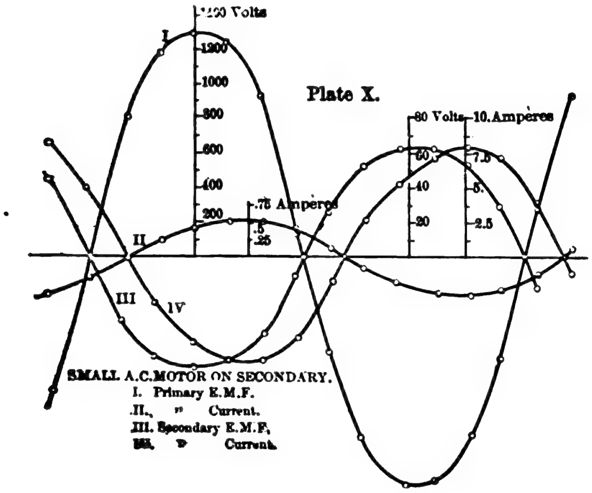
It is claimed that by means of this system the traction power of locomotives may be increased fully 25 per cent. over what it is at present; that engines thus equipped will be enabled to draw longer and heavier trains, to mount steeper grades and to make better time; that the wear and tear upon the wheels and rails due to slipping and the use of sand is avoided; that light locomotives having sufficient steaming power can do the work of heavier engines, thus avoiding the increased strain upon rails, road-bed, bridges, etc., and in many instances rendering the reconstruction of the latter for heavier traffic unnecessary; that the condition of the weather cannot affect the schedule time by reason of lessened tractive adhesion, as at present; that trains may be brought under headway and stopped more quickly by reason of the absence of slipping of the drivers due to the action of the current; that the consumption of fuel for generating the traction current is considerably less than the saving in fuel effected by the absence of slipping alone; that in many cases the running of passenger and freight trains in separate sections may be avoided, as well as the expense and delays to traffic occasioned thereby; that a passenger or freight train drawn by a locomotive equipped with this system is safer and under more perfect control on steep grades, and, finally, that the earning capacity of a line of road having its engines so equipped can be very largely increased.

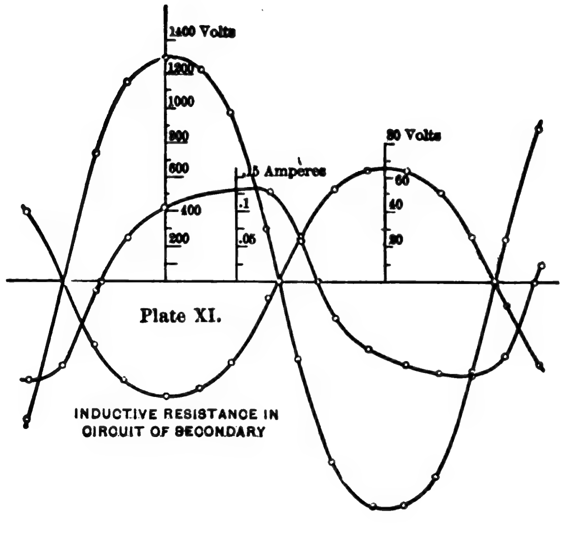
FIRE ALARMS IN NEW YORK CITY.

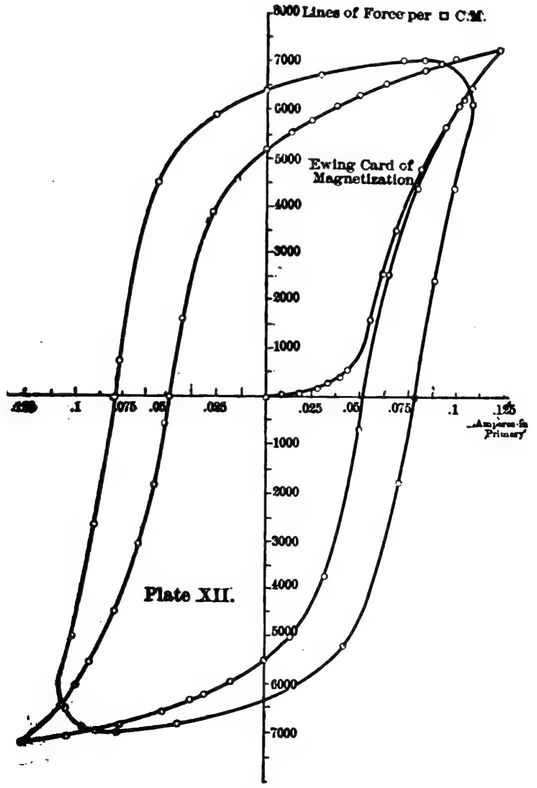
New York city is to have a new system of fire signals. Chief Hugh Bonner has devoted nearly all his spare time for more than a year to the new code, and J. Elliot Smith, the Superintendent of Telegraph at Fire Headquarters, has aided him as electrical expert. The new code is necessary because the city has outgrown the old signal box, and districts which were important have become unimportant, and vice versa. The aim of its compiler has been so to cover the city with signals that the number 999 should not be passed or reached, as beyond that number four figures would have to be employed, which would not only be troublesome but perilous. When it becomes necessary to have more than 999 signal stations a new system—probably one of districting—will have to be devised.











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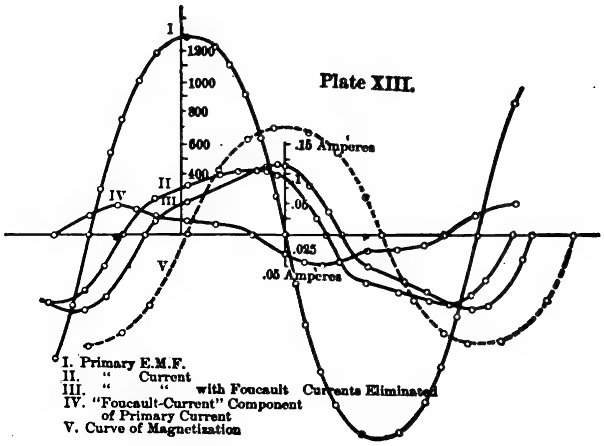

HUMPHREY AND POWELL ON TRANSFORMER EFFICIENCY.

CORRECT TIME—HOW SHALL WE MAINTAIN IT?[1]

BY H. S. PRITCHETT,

Sup. Time Service and Watch Inspection, Wabash Railroad.

The problem of furnishing and maintaining correct time has become within the past ten years relatively much more important than it was during the earlier history of railroading in the United States. Under the present system of train dispatching, requiring the movement of numerous trains of different classes over a single line of track, as is generally the case on our American roads, an exact and uniform time system is a necessary part of the safe and efficient operation of any railway. It may be stated here that a long step in the right direction was taken when the plan of uniform time over large areas, now in use, was adopted.

It may be stated at the outset that the matter of time service as it is involved in the practical operation of railroads will naturally come under the following heads:

1. The distribution of time signals to all stations.

2. The regulation of certain time pieces at division points, train dispatchers' offices and other important points, to serve as secondary time standards during the 24 hours intervening between the sending of time signals.

3. Even after providing for uniform and exact time in this manner, it is still desirable to provide by a judicious system of inspection that the time so furnished is actually kept in the pockets of the employees engaged in the movement of trains.

Assuming that the time can be thus obtained from some satisfactory source, the problem in which the telegraph department of the railroad is immediately interested, is the distribution of time signals. On our American railroads two plans of giving time to all offices have been in use. It may be stated in passing, that in this matter of time service our American roads are far beyond those of England or the Continent.

The first of the methods alluded to consists in obtaining time from some observatory by a central office, and then distributing by hand to all stations in accordance with an agreed programme. The other consists in an automatic service directly from the observatory to all stations. As nearly as can be ascertained, about 115,000 of the 160,000 miles of railway of the United States are being furnished with an automatic distribution of time signals direct from observatories. The advantages in favor of a direct automatic service are very great, and experience show that the value of such a service increases with time. These advantages may be stated as follows:

1. The automatic clock-beats direct from an observatory give the time with a precision which can be gained in no other way, and it is astonishing to see how quickly employees see and appreciate this. Many of the employees in the railway service now carry watches of high grade and watch the time with the utmost care. A time standard which varies, even by so little as two or three seconds, first one way and then another, will quickly lose their respect and attention. Experience has shown in a very conclusive way that nothing conduces more to the maintenance of correct and exact habits in employees than the furnishing of an absolutely exact time standard.

2. Again the automatic beats, if properly put on the wires, coming as they do with regular, rythmical contacts, can be transmitted in bad states of the wires when nothing else can.

At times there have been objections to the automatic observatory service. I believe it to be essential in any programme of time signals that the actual clock signals should be preceded by some warning, and that the plan of sending should be as simple as it can be made, and that the time consumed be as short as is consistent with giving several opportunities for identifying the minute and second.

The following programme of sending has been in use at the observatory of Washington University, St. Louis, for some years. It is largely the result of the practical experience of Mr. Hammond and Mr. Kinsman, and combines, I believe, all the qualities of simplicity and brevity mentioned above.

The entire programme occupies three minutes. The first minute is taken up in calling the word "Time." This necessitates, of course, the presence of an operator at the observatory and in fact makes the observatory one of the offices of the company, and the time service a part of the regular business of the railroad.

After calling "Time" for a minute the automatic signals are begun by the standard clock at two minutes before the hour, sending double beats each second for 50 seconds. The circuit is then opened for 10 seconds, and at one minute before the hour single beats begin and continue for 50 seconds, when again the circuit is opened for 10 seconds, followed at the exact hour by a single beat which is purposely prolonged to nearly a second in length to make sure of synchronizing clocks along the line of the road.

The apparatus in use in putting signals upon the wires is of an original design and has been found to work well in the transmission of signals over long distances. It consists of a platinum arc attached to the end of a second's pendulum clock, which swings through a narrow mercury contact. As long as the mercury is in contact with the platinum the circuit is closed. The circuit is broken by a small opening in the wheels of the arc. This opening is adjustable. The special advantage of the device is that the signals so produced are not instantaneous contacts, but hold the circuit closed an appreciable fraction of a second, so that there is no difficulty in repeating in this way over long lines.

Under such a system we find it entirely practicable to distribute observatory time signals to all stations with all the certainty that can be desired. Operators at all stations where time is received are required to be on hand and acknowledge the receipt of time by signing their office call. These signatures are recorded on a form by the train dispatcher of each division and by him are turned in to the superintendent of telegraphs at the end of each week. It requires only a glance at these to see how each man has looked out for time.

This regulation of requiring operators to be on hand to set clocks and acknowledge the receipt of time has proven to be of excellent practical value not only in creating and maintaining a careful attention to the matter of correct time, but also indirectly in the inculcation of exact and accurate habits. Furthermore it is often convenient to have each man at the key at a certain hour of the day.

The question of the proper hour at which time should be sent has been discussed for some years at various railway gatherings. Some years ago the General Time Convention recommended the hour of 4 o'clock, P. M. as that best suited for the distribution of railway signals. In accordance with that recommendation we began at St. Louis the distribution of time signals at that hour to a number of roads. After a trial of one or two years, however, nearly all these roads have gone back to the hour of 10 o'clock A. M. as being most convenient and best suited to railway purposes.

There are good reasons in favor of both the morning and afternoon hour, but on the whole I am of the opinion that 10 A. M. is as good an hour as can be selected for this purpose.

The consideration of the subject has so far been devoted entirely to the consideration of a practical system of distribution of time signals. It is necessary, however, in any system of railroad time service to provide at certain important points, such as train dispatchers' offices, fixed time-pieces to be regulated by the time signals, and which shall serve as secondary time standards during the 24 hours intervening between the sending of time.

The regulation and means of correcting these secondary standards would necessarily form a part of any practical time service which should be adopted. In the observatories the standard clocks are not corrected at all, but are allowed to accumulate their errors from year to year, the correct time being deduced at any moment from the known error and rate. In railroad service it is necessary to keep all time pieces within a very few seconds of exact time. The problem is to do this efficiently and practically without introducing too complicated apparatus.

The plan in use on most of our American roads is to have a clock of moderately good make, which is set right from the time-signals daily by the operator in charge. Such a time-piece should be capable of an easy and accurate setting of the hands. For this reason a chronometer is a very poor investment for a railroad company, since it is not only high priced but very difficult to set, and requires the services of a practical watch maker to look after it, in order to keep close to correct time.

The objection to this plan of regulating important time-pieces is that, unless orders are strictly enforced, operators allow a considerable error to accumulate before setting the clock, and then pull it up all at once like a run-away horse, the effect of which is to make employés lose confidence in the whole system.

For some years past various synchronizing devices have been in use on a number of roads for the purpose of setting clocks automatically by the time signals. The best known of these are the Self-winding Clock Company's synchronized clock and the Gardner synchronizer, which is now also owned by the Self-winding Clock Company. The former of these is wound by a small motor each hour, the power being furnished by two cells of Leclanché battery. Beside this self-winding attachment the clock has also a synchronizing device for setting the minute and second hands. The Gardner device, on the other hand, is applied to an ordinary clock, and the clock is dependent on the electricity for a correction only.

The problem of synchronizing a series of clocks by either of these devices is entirely easy and simple. In the system of time-signals which I have described the circuit is opened for 10 seconds just preceding the exact hour. During this interval the operator in charge of the clock to be synchronized needs simply to turn a switch, and the single beat coming at the exact hour sets the hands. This beat is purposely made nearly a second in length to insure a firm and decided closing of the circuit.

On the Wabash Railroad we have a synchronized clock at all train despatchers' offices. A careful record is kept daily by the operator in charge and turned in to me at the end of each month. It seldom happens that a clock fails to set, and they are rarely

1. Abstract of a paper read before the 9th Annual Meeting of the Association of Railway Telegraph Superintendents, Niagara Falls, June 19, 1890.

more than five seconds off from correct time at the end of twenty hours' run.

In spite of all this, however, there are many things which go far to neutralize the benefits to be derived in railroad work from the easy and accurate setting. We have for three years given these devices a very extensive trial, using both the self-winding clock and the Gardner device.

Both of these devices are excellent in their way, and can be used with perfect success in a large city where a considerable plant is maintained, and where a skilled man is on hand to remedy any trouble that may arise, either in the motor part of the clock or in the synchronizer. But when one comes to place these clocks at isolated stations scattered along several thousand miles of a great railway system the problem is of an entirely different sort.

A railway furnished with good ordinary clocks at important points can, by careful instructions to despatchers, keep these clocks within the limit of error attained by the synchronized clocks, and if the clocks are carefully rated they will not need to be set more frequently than two or three times a week, but their errors in seconds should be posted on a slip prepared for that purpose each day. If properly furnished with accurate time-signals the synchronized clocks are, in my opinion, of secondary importance in the practical operation of a railway time service. Even after furnishing exact time to all stations, and providing clocks at important points to serve as secondary standards, experience has shown that it is still necessary to follow this up and see that the time so provided is actually kept in the watches of employees that are engaged in the movement of trains.

LIGHTNING CONDUCTORS FROM A MODERN POINT OF VIEW [1]

BY PROF. OLIVER J. LODGE.

A LIGHTNING conductor used to be regarded as a conduit or pipe for conveying electricity from a cloud to the ground. The idea was that a certain quantity of electricity had to get to the ground somehow; that if an easy channel were opened for it the journey could be taken quietly and safely, but that if obstruction were opposed to it violence and damage would result. This being the notion of what was required, a stout copper rod, a wide-branching and deep-reaching system of roots to disperse the charge as fast as the rod conveyed it down, and a supplement of sharp points at a good elevation to tempt the discharge into this attractive thoroughfare, were the natural guarantees of complete security for everything overshadowed by it. Carrying out the rain-water-pipe analogue, it was natural also to urge that all masses of metal about the building should be connected to the conductor, so as to be electrically drained to earth by it, and it was also natural to insist on very carefully executed joints, and on a system of testing resistance of conductor and "earth" so as to keep it as low as possible. If ever the resistance rose to 100 ohms it was to be considered dangerous.

The problem thus seemed an easy one, needing nothing but good workmanship and common sense to make accidents impossible. Accordingly, when, in spite of all precautions, accidents still occurred, when it was found that from the best-constructed conductors flashes were apt to spit off in a senseless manner to gun-barrels and bell ropes and wire fences and water butts, it was the custom to more or less ridicule and condemn either the proprietor of the conductor, or its erector, or both; and to hint that if only something different had been done—say, for instance, if glass insulators had not been used, or if the rod had not been stapled too tightly into the wall, or if the rope had not been made of stranded wires, or if copper had been used instead of iron, or if the finials had been more sharply pointed, or if the earth-plate had been more deeply buried, or if the rainfall had not been so small, or if the testing of the conductor for resistance had been more recent, or if the wall to which the rod was fixed had been kept wet, or &c., &c.,—then the damage would not have happened. Every one of these excuses has been appealed to as an explanation of a failure; but because the easiest thing to abuse has always been the buried earth connection, that has come in for the most frequent blame, and has been held responsible for every accident not otherwise explicable.

All this is now changing or changed. Attention is now directed, not so much to the opposing charges in cloud and earth, but to the great store of energy in the strained dielectric between. It is recognized that all this volume of energy has somehow to be dissipated, and that to do it suddenly may be by no means the safest way. Given a store of chemical energy in an illicit nitroglycerine factory, it could be dissipated in an instant by the blow of a hammer, but a sane person would prefer to cart it away piecemeal and set it on fire in a more leisurely and less impulsive manner. So also with the electrical energy beneath a thundercloud. A rod of copper an inch or a foot thick may be too heroic a method of dealing with it; for we must remember that an electric discharge, like the recoil of a spring or the swing of a pendulum, is very apt to overshoot itself, and is by no means likely to exhaust itself in a single swing. The hastily discharged cloud, at first, suppose, positive, over-discharges itself and becomes negative; this again discharges and over-discharges till it is positive as at first, and so on, with gradually diminishing amplitude of swing, all executed in an extraordinarily minute fraction of a second, but with a vigor and wave-producing energy which are astonishing. For these great electrical surgings, occurring in a medium endowed with the properties of the ether, are not limited to the rod or ostensible conduit; the disturbance spreads in all directions with the speed of light, and every conducting body in the neighborhood, whether joined to the conductor or not, experiences induced electrical surgings to what may easily be a dangerous extent. For not only is there imminent danger of flashes spitting off from such bodies for no obvious reason—splashes which, on the drain-pipe theory, are absolutely incredible—flashes sometimes from a perfectly insulated, sometimes from a perfectly earthed, piece of metal; but, besides this, remember that near any considerable assemblage of modern dwellings there exists an extensive metallic ramification in the gas-pipes, that these are in places eminently fusible, and that the substance they contain is readily combustible.

On the drain-pipe theory, the gas-pipes, being perfectly earthed would be regarded as entirely safe so long as they were able to convey the current flowing along them without melting; but, on the modern theory, gas-pipes constitute a widely spreading system of conductors able to propagate disturbance underground to considerable distances, and very liable to have some weak and inflammable spot at places where they are crossed by bell wires or water-pipes or any other metallic ramification.

Above ground we have electrical waves transmitted by the ether, and exciting surgings throughout a neighborhood by inductive resonance. Below ground we have electrical pulses conveyed along conductors, leaking to earth as they go, but retaining energy sufficient to ignite gas, whenever conditions are favorable, at considerable distances.

The problem of protection, therefore, ceases to be an easy one, and violent flashes are to be dreaded, no matter how good the conducting path open to them. In fact, the very ease of the conducting path, by prolonging the period of dissipation of energy, tends to assist the violence of the dangerous oscillations. The drain-pipe theory, and the practical aphorisms to which it has given rise, would serve well enough if lightning were a fairly long-continued current of millions of amperes urged by a few hundred volts, or if there were no such thing as electromagnetic inertia; but, seeing that the inverse proportion between amperes and volts better corresponds to fact, and seeing that the existence of electromagnetic inertia is emphasized by multitudes of familiar experiments, the drain-pipe theory breaks down hopelessly, and only a few of its aphorisms manage to survive it.

What, then, are we to set up in place of this shattered idol? First of all we can recognise what was virtually suggested by Clerk Maxwell, that the inside of any given enclosure, such as a powder magazine or dynamite factory, can, if desired, be absolutely protected from internal sparking by enclosing it in a metallic cage or sheath, through which no conductor of any kind is allowed to pass without being thoroughly connected to it. The clear recognition of the exact, and not approximate, truth of this statement is a decided step in advance, and ought to be satisfactory to those who have to superintend the practical protection of places sufficiently dangerous, or otherwise important, to make the aiming at absolute security worth while. Similarly, for wire-covered ocean cables absolute protection is possible. But not for ordinary buildings, any more than for ordinary land telegraph offices, is such a plan likely to be adopted in its entirety. Some approximation to the cage system can be applied to ordinary buildings in the form of wires along all its prominent portions; and such a plan I have suggested, and I understand it is being carried out, for the entrance towers and part of the main body of the present Edinburgh Electrical Exhibition, Mr. A. R. Bennett having asked me to recommend a plan to the Committee as a sort of exhibit. For chimneys a set of four galvanized iron wires, joined by hoops at occasional intervals, and each provided with a fair earth, seems a satisfactory method; but it is to be noted that a column of hot air constitutes a surprisingly easy path, and that it is well to intercept a flash on its way down the gases of a chimney by a copper hoop or pair of hoops over its mouth. Mr. Goolden tells me that he has just applied this method to a new chimney at his works in the Harrow Road. For ordinary houses, a wire down each corner and along the gables is as much as can be expected. At many places even this will not be done; a couple of vertical wires from the highest chimney stacks on opposite sides must be held better than nothing or than only one.

Earths will be made, but probably they will be simple ones, entailing no great expense. A deep, damp hole for each conductor, with the wire led into it and twisted round an old harrow or a load of coke, may be held sufficient. And as to terminals, rudely sharpened projections, as numerous as is liked, may be arranged along ridges and chimney stacks; but I have at present no great faith in the effective discharging power of a few points, and should not be disposed to urge any considerable expense in erecting or maintaining them. Crowns of points on chimneys and

1. *Industries.*

steeples are certainly desirable, to ward off, as far as they can, the chance of a discharge, but a multitude of rude iron ones will be more effective than a few highly sharpened platinum cones. I find that points do not discharge much till they begin to fizz and audibly spit; and when the tension is high enough for this, blunt and rough terminals are nearly as efficient as the finest needle points. The latter, indeed, begin to act at comparatively low potentials, but the amount of electricity they can get rid of at such potentials is surprisingly trivial, and of no moment whatever when dealing with a thundercloud.

But the main change I look for in the direction of cheapness and greater universality of protection is in the size and material of the conducting rod itself. No longer will it be thought necessary to use a great thick conductor of inappreciable resistance; it will be perceived that very moderate thickness suffices to prevent fusion by simple current strength, and that excessive conducting power is useless.

In the days when the laws of common "divided circuits" were supposed to govern these matters, the lightning rod had to be of highly conducting copper, and of such dimensions that no other path to earth could hope to compete against it. But now it is known that low resistance is no particular advantage; it is not a question of resistance. The path of a flash is a question of impedance, and the impedance of a conductor to these sudden rushes depends very little on cross-section and scarcely at all on material. A thin iron wire is nearly as good as a thick copper rod, and its extra resistance has actually an advantage in this respect, that it dissipates some of the energy, and tends to damp out the vibrations sooner. Owing to this cause a side flash from a thin iron wire is actually less likely to occur than from a stout copper rod.

The only limit is reached when the heat generated by the current fuses the wire, or runs the risk of fusing it. But in so far as oscillations are prevented, the mean square of current strength on which its heating power depends is diminished. Accordingly, a fairly thick iron wire runs no great risk of being melted. Its outer skin, may, indeed, be considerably heated, for these sudden currents keep entirely to the outer skin, penetrating only a fraction of a millimetre into iron, and they make this skin intensely hot. But the central core keeps cool until conduction has time to act; and, consequently, unless the wire is so thin as to be bodily deflagrated by the discharge, its continuity is not likely to be interrupted. Thickness of wire is thus more needed in order to resist ordinary deterioration by chemical processes of the atmosphere than for any other reason.

But the liability to intense heating of the outer skin should not be forgotten, and care should be taken not to take the wire past readily inflammable substances for that reason. For instance, it would be madness to depend on Harris's notion that a lightning conductor through a barrel of gunpowder was perfectly safe, especially if said conductor were an iron wire or rod.

In the old days a lightning conductor of one or two hundred ohms resistance was considered dangerously obstructive, but the impedance really offered by the best conductor that ever was made to these sudden currents is much more like 1,000 ohms. A column of copper a foot thick may easily offer this obstruction, and the resistance of any reasonably good earth connection becomes negligible by comparison. A mere wire of copper or iron has an impedance not greatly more than a thick rod, and the difference between the impedance of copper and iron is not worth noticing.

But although, in respect of obstructing a flash, copper and iron and all other metals are on an approximate equality, it is far otherwise with their resistances, on which their powers of dissipating energy into heat depend. It is generally supposed that iron resists seven times more than copper of equal section, and so it does steady currents, but to these sudden flashes its resistance is often 100 times as great as copper, by reason of its magnetic properties. This statement is quite reconcilable with the previous statement, that in the matter of total obstruction there is very little to choose between them; the apparent paradox is explicable by the knowledge that rapidly varying currents are conveyed by the outer skin only of their conductor, and that the outer skin available in the case of magnetic metals is much thinner than in the case of non-magnetic.

Questions about shape of cross-section are rather barren. Thin tape is electrically better than round rod, but better than either is a bundle of detached and well-separated wires—for instance, a set of four, one down each cardinal point of a chimney; but it is easy to over-estimate the advantage of large surface as opposed to solid contents of a conductor. The problem is not a purely electrical one—it is rather mixed. The central portion or core of a solid rod is electrically neutral, but chemically and thermally and mechanically it may be very efficient. It confers permanence and strength; and the more electrically neutral it is, the less likely is it to be melted. Its skin may be gradually rusted and dissolved off, or it may be suddenly blistered off by a flash; but the tenacity of the cool and and solid interior holds the thing together, and enables it to withstand many flashes more. Very thin ribbon or multiple wire, though electrically meritorious, is deficient in these commonplace advantages.

There were two functions attributed to high conducting power in the old days—first the overpowering of all other paths to earth second, the avoidance of destruction by heat. The first we have seen to be fallacious; on the second a few more explanations can be made. In so far as fusion by simple current strength is the thing dreaded, it must be noticed that a good conductor has no great advantage over a bad conductor. It is a thing known to junior classes that when a given current has to be conveyed less heat is developed in a good conductor, but that when an electromotive force is the given magnitude less heat is developed in a bad conductor. The lightning problem is neither of these, but it has quite as much relationship to the second as to the first. There is a given store of energy to be got rid of, and accordingly the heat ultimately generated is a fixed quantity. But the rise of temperature caused by that heat will be less in proportion as the production of it is slow; and though by sudden discharge a quantity of the energy can be made to take the radiant form, and spread itself a great distance before final conversion into heat, instead of concentrating itself on the conductor, yet this cannot be thought an advantage. For, just as in the old days a lightning rod was expected to protect the neighborhood at its own expense by conveying the whole of a given charge to earth, so now it must be expected to concentrate energy as far as possible on itself, and reduce it to a quiet thermal form at once, instead of, by defect of resistance and over-violent radiation, insisting on every other metallic mass in its neighborhood taking part in the dissipation of energy.

The fact that an iron wire, such as No. 5 or even No. 8 B. W. G., is electrically sufficient for all ordinary flashes, and that resistance is not a thing to be objected to, renders a reasonable amount of protection for a dwelling-house much cheaper than it was when a half-inch copper rod or tape was thought necessary.

A recognition of all the dangers to which a struck neighborhood is liable doubtless prevents our feeling of confidence from being absolute in any simple system of dwelling-house protection; but at the same time an amount of protection superior to what has been in reality supplied in the past is attainable now at a far less outlay; while, for an expenditure comparable in amount to that at present bestowed, but quite otherwise distributed, a very adequate system of conductors can be erected.

Only one difficulty do I see. In coal-burning towns galvanized iron wire is, I fear, not very durable, and renewal expenditure is always unpleasant. It is quite possible that some alloy or coating able to avoid this objection will be forthcoming, now that inventors may know that the problem is a chemical one and that high conductivity is unnecessary.

ON THE TREATMENT OF ORES BY THE ELECTROLYTIC METHOD.

A well-known writer says in his work on metallurgy and in reference to the electrolytic treatment of ores: "During the past forty years many attempts have been made to extract metals from their ores by electrolysis, and many ingenious processes have been devised, but few of these, so far as we are aware, have proved successful. Some of the earlier investigations of Bunsen, Sainte-Claire Deville, and Becquerel are of special importance as indicating the general principles upon which such electrolytic operations may be conducted; there is little doubt, however, that much has yet to be done before the separation of the metals from their ores will attain the position of a really practical branch of electro-chemistry. We have noticed in the cases of copper refining by the wet way, that many attempts were made in this direction long before a commercially successful application of the electrolytic method was arrived at, and we still hope and believe that electricity will be practically employed in extracting metals from their ores; indeed, some trials which we have recently made in this connection are at least of a very hopeful character." This paragraph could now well be eliminated from his work. Electrical engineering firms for the past three years have given this branch of the profession great attention, and with the result that their efforts in constructing dynamos especially adapted for this work have been successful. The United Edison Company, with their unusual facilities for the manufacturing of generators, promptly exploited this field, and are now turning out dynamos to develop any amount of current requisite for the capacity of the works treating the ores.

Many mine owners and operators of existing plants treating ores in the old method have, from time to time, been considerably exercised in their minds in reading and hearing reports and marvellous statements about the out-put of the establishments already provided with plants for treating copper ore electrolytically. These points are:—

1. The pureness of copper deposited.
2. The recovery of the gold and silver obtained by no other method.
3. The cheapness of production.
4. The ready sale of the product.

These statements are so far true, but the mine owners, on investigating the matter, have had great obstacles thrown in their way, getting no information as to the construction of the plants, and being told that the method is altogether conducted in a secret

manner. This consequently has dampened their ardor and they have returned to their old system of conducting their operations. But it may be at once stated that there is no real secret process. Owners of electrolytic plants have only adopted the ordinary wise and business caution when they have a good thing, of keeping it, as far as possible, to themselves. The United Edison Company, with a thorough knowledge of the whole system, now inform us that they will contract with parties to furnish them with a complete plant, including motive power and generators, baths, pumps, and with all the necessary information for conducting, with financial success, the operations of treating any ores by the electrolytic method.

CORRESPONDENCE.

BOSTON.

Marriage of Mr. H. C. Spaulding.—Anniversary of Boston Electric Club.

THE many friends of Mr. Hallon Curtis Spaulding, general manager of the Thomson-Houston Motor Company, are congratulating him upon the occasion of his marriage to Miss Lucille Brisbine, of Nashua, N. H. The ceremony took place on Tuesday afternoon, the 24th inst., after which Mr. and Mrs. Spaulding departed for a month's trip in the west. The ushers were Mr. G. W. Mansfield, T. W. Sprague, Frank Codman, H. C. Glover, F. L. Locke, of Boston, and Dixi Crosby, of New York, with Mr. H. B. Prindle, as chief usher. The ceremony was at the Church of the Good Shepherd, Rev. W. H. Moreland, rector, officiating. The music was very elaborate, being sung by a vested choir of 40 boys. The church was decorated, and filled with admiring friends. Fred. B. Lovejoy, of Boston, was best man, Miss Sophia Walton, of New York, maid of honor, and six young ladies served as bridemaids. Mr. Spaulding enjoys the good wishes of a host of friends among the electrical fraternity.

THE Boston Electric Club celebrated its third anniversary by a delightful outing on Saturday last, to the Nanepashemet House, on Marblehead Neck. Members and guests took the 12.30 train to Marblehead, reaching the Nanepashemet House by barges about 2 o'clock, where a sumptuous fish dinner was served at once.

President Cram presided at the table, and after dinner said a few words congratulating the members upon the continued success of the club. His remarks were quite brief, however, as members were more anxious to be out enjoying themselves in the open air than to hear speeches, however interesting. A photograph of the group was taken on the balcony of the hotel, and a subsequent view of this picture impresses one with the idea of how many stalwart, handsome men there are in the club; not a few of them, moreover, evidently being keen sportsmen. A unique game of base ball then attracted attention, good, bad and indifferent players all alike vieing with one another to emulate a Kelly or a Ward. Without mentioning any names we may say that there were a number of the members who showed their prowess in the game, and "home runs" were of frequent occurrence, the happy hitter being rewarded by getting his arm nearly shaken off by his associates. At the close the score stood 24 to 16, and the game was gracefully awarded to the winners with a rousing cheer. The party left for Boston at 6 o'clock, and indulged in songs and speeches, and made things merry till Boston was reached, when everyone agreed that a most enjoyable time had been spent.

THE investigation into the charges of improper influence alleged to have been employed at the legislature to secure the passage of elevated railroad bills is concluded. The committee will probably report early next week and the session will then be brought to a speedy close.

BOSTON, June 28, 1890.

PITTSBURG.

Printing by Electric Motor.—The Allegheny City Municipal Plant—Electric Railway Work.

The Western Democrat is the first newspaper in the state of West Virginia printed by electric power. The first issue brought out with the aid of the electric motor appeared on the morning of June 23d.

The citizens of Allegheny have now decided not to start with the operation of their electric light plant until July 18. This change has been made for the reason that on that day the city will hold its semi-centennial celebration, and it is proposed to have the electric lights play an important part in the festivities. Arrangements have been made to light the entire plant on the evening of the celebration, and in order to make the effect more brilliant, all the incandescent and arc lamps will be covered with colored globes of various hues and shades.

The Wilkins and Braddock street railway company and the Pittsburg, Braddock and Turtle Creek street railway company received their charters at Harrisburg, Pa., a few days ago; capital, $36,000.

A large corps of workmen were started last week on the lines of the Pittsburg, Allegheny and Manchester railroad company for the purpose of putting down new tracks. This is the road which, at a meeting held not long ago decided to change its motive power and adopt an electric street car system. The councils of Allegheny city passed an ordinance granting the company the right to do so, provided the company would begin making the change before the first of July. It was in conformity with this ordinance that the workmen were set to work last week. The P., A. and M. passenger railway company controls the Western avenue line, the Union line, the Rebecca street line, the Troy Hill line and the Allegheny Transverse line, running 100 cars every day. The contract for the electric equipment of the road has not been let yet, but a decision will be made in this direction very shortly.

PITTSBURG, June 27, 1890.

CHICAGO.

Bids for City Underground Cable.—The People's Electric Light Co.—The Cicero and Proviso Street Railway Co.

BIDS were opened last week by Controller Onahan for thirty miles of electric light cable for underground use. It is understood that the contract for the same will be placed with the Cobb Vulcanite Wire Co., of Wilmington, Delaware, who were the lowest bidders.

The backers of the People's Electric Light Company are demanding that the city carry out the provisions of the contract entered into between that company and the old Town of Lake for the maintenance of 200 arc electric lights at $12.50 a lamp per month, and the city will probably refuse to do so on the ground that one corporation can not bind a succeeding similar corporation to a contract. The contract has been submitted to the city officers. It is dated July 13 of last year, and is specific as to lamps, their location, the rate, and the time of the contract, a period of four years.

The Cicero and Proviso Street Railway Company has applied to the public works department for a permit to lay tracks for an electric street car line in that portion of the city formerly a portion of Cicero. The franchise of the company is dated April 18, 1889, and the promoters say it was pending several months before that. A power-house has been erected, the company says, and they wish a permit to go to work on the streets named in the franchise: Madison, from Fortieth street to Harlem avenue; Lake and Forty-eighth streets to Harlem avenue; Harlem avenue and Forty-eighth street, from Lake to Madison. No permit has yet been obtained from the Cicero authorities. The law department is looking over the ordinance.

CHICAGO, June 27, 1890.

SOCIETY AND CLUB NOTES.

THE CHICAGO ELECTRIC CLUB.

The banquet of the Chicago Electric Club, held at Kinsley's, Friday evening, June 27, was a decided and magnificent success notwithstanding the abnormally high temperature under which the city has been suffering for the past few days. The attendance was large among both the club members and their friends, and the fair sex, without whom an occasion of this kind would be but a tame and uninteresting event, were well represented. A magnificent repast was served in Kinsley's handsome banqueting hall and ballroom. The tables were beautifully and tastefully decorated with flowers, and the viands were enjoyed to the accompaniment of the delightful music of the harp and the tinkling strains of the mandolin, which was by no means the least attractive feature of the entertainment. After dinner the gentlemen retired for a short time to the club room, where two highly interesting papers were read, one by Prof. J. E. Siebel on "Thermo Chemistry in Relation to Electromotive Force," and the other by J. K. Pumpelly, on "The Storage Battery in Traction Work."

After this, dancing was the order of the evening, and a delightful entertainment appreciated by all was brought to a close about 1 P. M. The following prominent in Chicago and neighboring electrical circles were among those present:

Alexander Kempt and ladies; John Barton Payne; J. B. Carney and wife; J. K. Pumpelly; W. B. Pearson; Ernest Hœfer; W. A. Kreidler; A. C. Durborow, Jr.; J. W. Dickerson and Frank L. Perry; G. M. Smith; Geo. Buckley; Thos G. Grier; B. E. Sunny; Fred. DeLand; W. A. Hovey; R. E. Lee; H. A. Armstrong; Geo. Cutter, wife and lady; Chas. G. Armstrong; H. R. Hinson; Edwin R. Crolius; Gus A. Harter; Wm. H. Harding; C. M. Spaulding; Myron A. Knapp; W. J. Buckley and lady; F. E. Degenhardt and wife; Geo. C. Bailey; Chas. E. Gregory; D. B. Dean; W. S. Boyd; F. M. Ireland; S. J. Keese and wife of Los Angeles, Cal.; K. McLennan and wife; H. L. Reiwitch; A. Scheible; W. W. Nicholls and W. Forman Collins of and many others. Much praise is due the entertainment committee who so ably carried out all the arrangements and made the evening most agreeable and one to be remembered by all present.

LITERATURE.

Brown's Directory of American Gas Companies. Compiled by E. C. Brown. *Press of "Progressive Age."* New York, 1890. Price, $5.

THIS is one of the most useful and accurate publications of its class, and has now made its third annual appearance. It is something more than a mere directory list, there being given very full statistics in regard to each company. It appears that there are now 1,048 gas companies in America, or about 500 short of the number of electric light companies, and as 304 gas companies are doing an electrical business, the proportion in favor of electricity as an industry is, on this basis, fully two to one. Mr. Brown has included also the natural gas companies and a full list of the members of the American Gas Light Association, Ohio Gas Light Association, Western Gas Light Association, etc. There is also a very interesting little section giving explanations of the various "processes" mentioned in the work. Another section shows graphically the growth of water gas lighting, the total of plants being no fewer than 367. The work is prefaced by a large, clear map on which are the names of all the gas towns of the United States. The work is clearly typed, the information desired can be gathered at a glance, and the volume is rendered thoroughly substantial by being bound in cloth boards.

The Electric Railway of To-day. By H. B. Prindle, 55 pages. Illustrated. Boston, Mass: *E. B. Stillings & Co.* 1890. Paper, 50 cents; cloth, $1.

This is an excellent work, for which there should be a very general demand. Mr. Prindle gives not only a popular description of electric railroading, but enters into a clear and intelligible discussion of the technical points involved, and offers a number of shrewd suggestions as to the lines along which progress may be expected. The illustrations are excellent, many of them being very useful and interesting details of construction and operation. Any person can form an idea as to the methods adopted, even if he has never seen an electric road running; and we can readily imagine that to some railroad superintendents the diagrams would be very helpful. The book concludes with a list of electric roads building or operating May 1. We congratulate Mr. Prindle on his neat and timely little book. He should now repeat the experiment with the stationary motor.

REPORTS OF COMPANIES.

AMERICAN BELL TELEPHONE CO.

The American Bell telephone statement of instruments for the month to June 20, records a net increase of 1,414, or more than 50 per cent. of the increase for the half year, as see the following :—

Month June 20.	1890.	1889.	Increase.
Gross output	7,758	6,511	1,247
Returned	1,927	2,094	*169
Net output	5,831	4,417	1,414
Since Dec. 20.	1889-90.	1888-9.	
Gross output	33,577	30,216	3,361
Returned	12,104	11,281	823
Net output	21,473	18,935	2,538
Instruments in use June 20	466,334	430,476	35,858

*Decrease.

THE INTERNATIONAL OKONITE COMPANY (L'T'D.)

The announcement is made of the formation of the International Okonite Co., Limited, to handle the large business in Okonite wires and cables that has grown up under the spirited and enterprising management of the Okonite Company of this city, and to develop a similar business in England. The capital of the new company is represented by 17,000 preference shares of £10 each; 17,000 ordinary of £10 each, and 1,000 six per cent. debentures of £100, being a first charge on the whole undertaking. The preference shares are entitled to 8 per cent. preferential dividend, and to a bonus of 2 per cent. additional out of surplus profits every year after the ordinary shares receive 15 per cent. From the remaining profits the ordinary shares will then be entitled to a bonus of 5 per cent. It is stated that the net profits of the Okonite Company in 1887 were $37,601; in 1888, $51,207; in 1889, $115,802; and that in 1890 they bid fair to reach $200,000. The property acquired in England is that of Shaw & Connolly, the wire and cable manufacturers at Manchester, who will add the manufacture of Okonite specialties to their existing business.

It is stated that 5,500 preference and ordinary shares have been applied for by the directors, besides those applied for by their friends; and that 11,300 preference and ordinary shares will be allotted in part payment of the properties. The businesses are to be taken over as going concerns from January 1, 1890.

The negotiations have been carried through chiefly by Mr. F. Cazenove Jones, of the Okonite Co., and Mr. F. L. Rawson, of Woodhouse & Rawson United, Limited. The directors of the new company will be Lord Greville; Samuel Pope, Esq., Q. C.; Major Jones, R. A.; Sir Alex. Armstrong, K. C. B., F. R. S.; H. Dobree, Esq.; J. H. Cheever, Esq.; J. L. Martin, Esq.; H. Durant Cheever, Esq.; F. Cazenove Jones, Esq., and W. L. Candee, Esq.

The price to be paid by the company for the businesses to be acquired as going concerns (all debts being paid and received by the Okonite Company and Messrs. Shaw and Connolly up to 1st January, 1890), including the leases of the buildings, the plant and machinery, stock in trade, patents, licenses, trade marks, processes, contracts, and good-wills, has been fixed by the vendors, Woodhouse and Rawson United, Limited, who are the promoters, at the sum of $1,576,201, of which $549,650 is payable in Preference and Ordinary Shares and $161,505 in Debentures, and the balance in cash; the vendors pay all preliminary expenses up to the first allotment of shares. The present issue of capital after payment of the purchase money will leave over $533,500 for working capital.

Winslow, Lanier & Co. are the bankers to receive applications for shares and debentures in this country.

DIVIDENDS.

THE INTERNATIONAL BELL TELEPHONE CO. has declared a semi-annual dividend of 3 per cent., payable July 1.

THE CONSOLIDATED ELECTRIC LIGHT CO., of New York, has declared a quarterly dividend of 1¼ per cent., payable July 1.

STOCKS AND BONDS.

THE EDISON ELECTRIC ILLUMINATING CO, of this city, has made application for the listing of $2,000,000 first mortgage 5 per cent. convertible gold bonds.

THE CENTRAL AND SOUTH AMERICAN TELEGRAPH COMPANY has filed notice of an increase of capital stock from $5,000,000 to $6,000,000. The stock is to be given to the holders of the $1,000,000 construction certificates, issued in the early part of the year for the extension of its cable to Valparaiso, Chili. The cable will be finished Jan. 1, 1891.

REJECTING THE NEW YORK LIGHTING BIDS.

All the bids made by the electric light companies for street lighting were rejected last week by the Gas Commission. The proposals put in last April showed that the companies, as though by arrangement, had united in asking about 25 per cent. more than last year's prices. The companies allege that the increase was necessary because of the rents of the subways and the removal of the overhead wires. The Gas Commission, however, decided that the bids were altogether too high, and if the contracts were granted the appropriation which was made on the basis of the old rates would be exceeded.

The commission ordered advertisements for new proposals and decided to go back to gas for street-lighting purposes if the bids are not low enough to bring the charges for electric lighting within the appropriation.

THE PLANT OF THE HALIFAX, N. S. ILLUMINATING AND MOTOR CO.

A very fine station has just been started at Halifax, N. S., by the Halifax Illuminating and Motor Co. The electric station is erected on Moren's Wharf, which is situate very centrally at the south-eastern portion of the city. This property was purchased by the company some time in the month of November, and consists of a lot with a frontage on Water street of about fifty feet and runs eastwardly to the harbor about 230 feet, where the width for about one hundred feet is over eighty-five feet. The water lot is 80 by 300 feet, and has upon it a new and capacious wharf, while the depth of water is ample for all kinds of shipping. The station is a substantial two-story brick building. The boiler room is about forty feet square and the engine and dynamo room is 40x50 feet. The boiler room is furnished with four tubular boilers six feet in diameter and 16 feet in length, made of half inch steel and so constructed as to stand a pressure of at least 120 pounds to the square inch. Each boiler connects from the top by an eight inch steam pipe with a twelve inch pipe running the whole length of the engine room, about three feet from the second floor. In the engine room nearly beneath this pipe are set four compound engines, one of the Armington & Sims type and three of the McIntosh & Seymour engines, for which John A. Grant & Co., of Boston, are the agents. These engines were all made to order and specially designed in all their running parts for the special work of this company. The dynamos belt direct from the fly wheels of the engine. The engines are all high speed and are run at the rate of about 260 revolutions to the minute. Their united capacity aggregated about 600 h. p.

The electrical plant consists of seven new arc dynamos, each of a capacity of fifty lights, of 2,000 of candle power, two incandescent alternating dynamos, of a united capacity of 3650 sixteen candle power lights. The switch board covers an area of about 30x12 feet, is made of black walnut and cherry and in its arrangement and construction was designed by the superintendent, R. A. Cogswell.

J. W. DeBlois is manager of the company; R. A. Cogswell, superintendent; and W. Wisdom, chief engineer.

LEGAL NOTES.

SWAYING WIRE—W. B. SHELDON vs. W. U. TELEGRAPH CO.

Judgment for $3,346.68 is affirmed in favor of Wilson B. Sheldon, who sued the Western Union Telegraph Company to recover for personal injuries received by running against a swaying wire extending from one of the company's poles in a highway in the town of Beekman, Dutchess County. The question involved was: Was it a careless and unwarranted use of the highway by the company, and this the Court of Appeals answers affirmatively.

TELEGRAPH PATENTS.—J. E. BLOOM vs. J. M. SEYMOUR AND F. J. PATTEN.

Col. John E. Bloom claims that James M. Seymour and Francis J. Patten are endeavoring to deprive him of his interest in certain patent-rights in connection with valuable multiplex telegraph inventions, and he has obtained from Judge O'Gorman of the Superior Court an order, with a temporary injunction, requiring them to show cause why they should not be restrained from parting with the patents pending his suit to establish his interest in the property. Patten was the inventor of the instruments, and, as claimed, he contracted with Bloom for the sale of them, and the contracts were duly recorded. Patten afterwards made a similar contract with Seymour. Col. Bloom in his suit demands $200,000 damages, but he alleges that both Patten and Seymour are unable to pay any judgment which may be obtained against them. The defendants, through Semple & Cahill, have demurred to the complaint. This demurrer has not yet been passed upon by the court. The system in question was fully illustrated and described in THE ELECTRICAL ENGINEER, of June 18.

TEARING AWAY RIVER CABLE—WESTERN UNION CO., vs. INMAN STEAMSHIP CO.

Judge Brown of the United States District Court in this city handed down on June 24 a decision in counter suits for libel brought by the Western Union Telegraph Company and the Inman Line Steamship Company, respectively, finding in favor of the steamship company and dismissing the libel brought by the Western Union. The litigation arose over the tearing away of twelve cables of the Western Union Company by the propeller blades of a steamer becoming entangled in them while attempting to swing out from a North River pier. The cables got so completely entangled in the blades that the vessel had to be placed on a dry dock for repairs. The steamship company's claim was for $2,000 damages, which is allowed. The amount claimed by the Western Union Company was $10,789, which was spent in repairing the broken cables, and $50,000 addition for damages sustained by the company's being deprived of the use of the injured cables during a period of sixteen days that it took to restore them to proper working order. The accident occurred on August 19, 1887.

In the suit brought by the Western Union Company, the claim was set up that it had the exclusive right to the use of the mud or silt for its cables, and that the propeller of the *City of Richmond* struck the cable while it lay embedded below the surface. Judge Brown, in his decision, says that such a right is not upheld under the language of the act of Congress relating to submerged telegraph cables. He points out that the act permits cables to "go under water, but not so as to obstruct navigation." Nothing in the act, he declares, gives any absolute right to lay cables in all cases on the very top even of solid bottom. Vessels docking near the point where the accident occurred have frequently to plough their way through navigable mud.

"There can be," he adds, "no practical difficulty in sinking cables so deeply as not to possibly interfere with the movements of vessels in any and all emergencies of navigation. The use by steamers in this harbor of the undefined margin of silt or mud between the solid bottom and clear water is necessary. Every inch that can be utilized is needed and should be scrupulously preserved for the uses of navigation against all unnecessary interference."

ELECTRICAL EXECUTION—KEMMLER vs. DURSTON.

The case of the people ex rel. Kemmler *vs.* Durston, warden of the Auburn State Prison, came up before the New York State Court of Appeals on June 23. W. Bourke Cockran argued for Kemmler on the sole question whether the Legislature had the power to legislate so as to take away any of the duties or powers of any sheriff of any county as it did in the present case and invest another officer, as in this case with that power. He claimed that the law was unconstitutional and void because it assumes to deprive the sheriff of Erie County of powers conferred on him by the Constitution. He submitted that the provision of the Constitution which guarantees to the electors of the various counties in the State the right to select sheriffs by popular suffrage, confers upon them the right to select an officer who shall forever execute the powers which were vested in the sheriff when the Constitution took effect, and that when such officer is shorn of any of his powers that provision is violated. Counsel argued that the act, so far as it attempts to give the custody of the relator to the warden being void, and the relator being detained by a person not having a shadow of authority, and being confined out of the county of his conviction and in an unauthorized building, it follows that he is illegally restrained and deprived of his liberty. Counsel asked that the Court should reverse the order of the General and Special Terms and make an order directing the warden to discharge the relator from custody.

Attorney-General Tabor began his argument by reviewing the course of the counsel for Kemmler in going through all the courts in the country in behalf of his clients when Chief-Justice Ruger cut him short by remarking that further argument was unnecessary, as the Court was ready to render a decision at once. The decision was in effect, that the Court believes that the Legislature had the power to make the law in question; and the decision of the lower court was affirmed.

INVENTORS' RECORD.

Patents issued June 24, 1890.

Alarms and Signals:—*Burglar-Alarm*, J. Winegarden, 430,979. *District Police and Fire Telegraph*, C. C. Drake, 430,992.

Conductors, Conduits and Insulators:—*Insulator*, W. H. Seamon, 430,696. *Composition of Matter*, F. N. Boxer, 430,766. *Insulating-Joint*, E. P. Gennert, 430,846.

Galvanic Batteries:—*Galvanic Battery*, J. H. Davis, 430,990.

Distribution:—*Regulation System for Electric Circuits*, C. O. Mailloux, 430,868.

Dynamos and Motors:—*Regulator for Dynamos*, W. H. Elkins, 430,634. *Dynamo or Magneto-Electric Machine*, T. A. Edison, 431,018.

Lamps and Appurtenances:—*Electric-Lamp Support*, James Chase, 430,622. *Incandescent-Lamp Hood*, J. Heath, 430,645. *Arc-Lamp*, J. J. Wood, 430,722. *Manufacture of Incandescent Lamps*, T. A. Edison, 430,932. *Filament for Incandescent Lamps*, T. A. Edison, 430,933. *Electric Lighting System*, T. A. Edison, 430,934.

Metallurgical:—*Magnetic Ore-Separator*, H. B. Smith, 430,758.

Metal-Working:—*Method of Electric Welding or Metal-Working*, M. W. Dewey, 430,833. *Apparatus for Working Metals by Electricity*, M. W. Dewey, 430,839.

Miscellaneous:—*Magnetic-Power Equalizer*, W. W. Alexander, 430,606. *Electro-Magnetic Combination Lock*, W. W. Alexander, 406,607. *Electro-Mechanical Combination Lock*, 406,608. *Electric Temperature Regulator*, L. F. Easton, 430,633. *Electric-Circuit Controlling Apparatus*, E. R. Gill, Jr., 430,636. *Electric Lock*, C. B. Beers and W. B. Tuttle, 430,764. *Electrical Calculating System*, H. Hollerith, 430,804. *Fusible Cut-Out*, J. N. Miller, 430,967. *Electric Connection*, H. Sauche, 430,974. *Carbon for Electrical Purposes and the Process of Making It*, J. H. Davis, 430,991. *Dental-Engine Motive Gear*, P. Brown, 431,020.

Railways and Appliances:—*Automatic Signal and Switch Controlling Apparatus and Verifying Mechanism*, E. R. Gill, Jr., 430,637. *Trolley-Carrier*, D. C. Nelson, 430,675. *Switch for Electric Locomotives*, F. B. Rae, 430,686. *Electric Railway*, W. Robinson, 430,690. *Suspending Device for Electric Conducting Wires*, W. M. Davis, 430,926. *Electric Railway Signal*, W. J. Smith, 431,011. *Block Signaling System for Railroads*, M. S. Conly, 431,017.

Telegraphs:—*Commutator for Induction-Generators for Telegraph Lines*, W. S. Richards, 430,688.

Telephones and Apparatus:—*Telephone-Exchange Apparatus*, J. J. O'Connell, 430,747. *Telephone-Exchange Key-Board Apparatus*, J. J. O'Connell, 430,748. *Graphophone*, R. H. St. John, 430,759. *Telephone Mouth-Piece and Holder*, E. B. Bell, 430,913. *Telephone System*, I. Kitsée, 430,960.

EXPIRING PATENTS.

Patents relating to Electricity which become Public Property in July, 1890.

Reported for THE ELECTRICAL ENGINEER, *by* F. B. Brock, *Patent Attorney, 639 F street, Washington, D. C.*

Recorder, F. S. Baldwin, 140,340, July 1, 1873. *Printing Telegraph*, T. A. Edison, 140,487, 140,488, 140,489, July 1, 1873. *Railway Signal*, F. L. Pope, 140,536. *Gas Lighting*, A. Potter, 140,591, July 8, 1873. *Connector*, S. D. Field, 140,618, July, 8, 1873. *Railway Signal*, H. W. Spang, 140,737, July 8, 1873; F. L. Pope, 140,790, July 15, 1873; D. Rousseau, 140,953, July 15, 1873. *Printing Telegraph*, G. M. Phelps, 141,076, July 22, 1873. *Recorder*, J. C. Hinchman, 141,352, July 29, 1873. *Railway Signal*, D. Rousseau, 141,387, July 29, 1873; H. W. Spang, 141,395, July 29, 1873.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

NEW FORT WAYNE PLANTS.

Mr. H. C. Adams, the agent of the Fort Wayne Electric Co., 115 Broadway, advises us that their Mr. C. S. Knight has just closed a contract with the United Gas Improvement Co., of Philadelphia, for 600 new Wood arc lights to be run in connection with their gas works at Kansas City, Mo.

The New York office has also closed a contract with the Raritan Electric Light and Power Co., Perth Amboy, N. J., for a 600 light Slattery alternating incandescent plant.

NEW WORK OF THE INTERIOR CONDUIT AND INSULATION CO.

The Interior Conduit and Insulation Co. are now making carload shipments daily, of tube, throughout the country. The new underground tube seems to have met with a great deal of satisfaction. The company have a contract for furnishing the underground conduits for St. Paul and Minneapolis, and they have also sold several thousand feet to the Pennsylvania Railroad Company for their underground work.

They have made quite a shipment to Japan, on orders received from there, and will probably make a shipment to Germany during the coming week. The company's new and commodious quarters now enable them to turn out tubes in large quantities, although they have not as yet succeeded in catching up with the orders, but it is probable that this will be done before the middle of the coming month, as their output has been increased tenfold.

The initial job of this company, the Shoreham Apartment House, Washington, D. C., owned by the Hon. L. P. Morton, has now been in operation about eight months and never has given any trouble since the plant was turned over to the purchaser. That it is an unqualified success is evidenced by the fact that Mr. Morton is now preparing to build an extension of the Shoreham House, and it is specified by the architects throughout the entire new building. As this company is not doing any construction work, the architects desire, as a special favor, that it shall be put in under their supervision.

THREE MORE WESTINGHOUSE PLANTS.

The Merchants Electric Light and Power Company, of Frankfort avenue, Philadelphia, Pa., is an organization which has recently been established there by prominent citizens of the "City of Brotherly Love." The company has given a contract to the Westinghouse Electric Company for one of its 750-light alternate current apparatus.

Not long ago the Westinghouse Electric Company installed its alternate current apparatus in Salt Lake City, Utah, and now the report has been made that another town in the Mormon State is about to establish an electric light plant within its precincts. A company has lately been organized in Ogden, Utah, and the Westinghouse Electric Company is going to install alternate current apparatus for a central station plant of 1500 incandescent and 80 arc lights.

The streets of Rockville, Ind., are shortly to be lighted by the Westinghouse alternate current arc light system. A plant of 50 lights has already been contracted for and the installation of the machinery is to be immediately begun.

AYRTON & PERRY INSTRUMENTS.

We learn from Queen & Co., of Philadelphia, that, in consequence of the great demand for Ayrton & Perry's magnifying spring ammeters and voltmeters, they have much increased their already large stock of these instruments and can fill orders for all the regular ranges without delay. The cardinal points in these instruments, are portability, freedom from magnets, (hence they are not affected by dynamos), and direct reading scales which are at the same time proportional throughout. That the Ayrton & Perry meters are appreciated is shown from the great demand for them during the last few years. They have been and are now used very extensively on electric railroads.

TROPICAL AMERICAN TELEPHONE COMPANY.

The Tropical American Telephone Company will close its books July 1 for the annual meeting July 8. The company reports its business increasing and its field broadening every month, and the management hopes to earn 10 per cent. on its business for the past year. It starts out with an order for 500 complete sets of instruments for one sub-company, an order of 100 sets for a second, and 300 sets for a third, beside a large order for Brazil. There has been acquired, to be turned over to the Tropical company July 1, control of the Williams annunciator drop, patented April 8, 1890, used in small exchange switchboards. This will enable the company to manufacture its own switchboards and levy a royalty on all drops of the above pattern used in the United States.

SUCCESSFUL TRIAL OF A STORAGE BATTERY CAR IN PROVIDENCE.

The United Electric Traction Company, of New York, have made a successful trial trip of their new car on the lines of the Providence street railway. The car is of the same pattern as those run for a while on Fourth avenue, New York, and is very comfortable. Power is applied by two Thomson-Houston motors, and the car floor is one step above the platform. There are two iron folding gates at each end of the car. The car is lighted by six 16 candle power incandescent lamps, and weighs seven tons with all its appurtenances. The motors are 10-horse power each, and are wound for 250 volts. Underneath the seats on each side of the car there are six trays of cells and nine cells in each tray, making 54 cells on each side and 108 in the car. By what is called the elevator system, the cells may all be removed from the car on the outside and another set be substituted in the space of one minute.

THE WIGHTMAN ELECTRIC MANUFACTURING CO.

This company, which has just been organized with headquarters at Scranton, Pa., proposes to manufacture specialties and to give special attention to all kinds of electric railway repair work, as well as electrical repairs in general. They have recently brought out an improvement in the method of winding motor armatures, particularly in the connections of the winding with the commutator, by which these are preserved intact, and the troubles heretofore encountered are entirely overcome. Mr. Merle J. Wightman, the well-known electrician, lately associated with Prof. Elihu Thomson, will be the electrician of the company, which is already busy on numerous orders. The officers of the company are: President, Lathrop R. Bacon; vice-president, Merle J. Wightman; secretary and treasurer, Horace E. Hand; and general manager, Herman Bergholtz.

THE RAE-PUMPELLY STORAGE CAR.

The new storage battery car built by the Detroit Electrical Works, Detroit, Mich., made a trial trip last week from the foot of Woodward avenue to the Mack road and Gratiot avenue and return for the benefit of the city railroad officials. The car climbed the steep grade from the river to Jefferson avenue without any trouble and made the entire distance at a much higher rate of speed while running than an ordinary horse car. This was accomplished by running until the car in front was reached, and then stopping until the car behind caught up. The car started on a grade of 7½ per cent., and ran around a switch and short curve. Notwithstanding these were severe tests, they were accomplished with ease, much to the surprise of the railroad men, some 30 in number on board. Amongst the street car men present were President George Hendrie, Treasurer Strathearn Hendrie, Secretary Cameron Currie and Superintendent Hugh O'Brien. Others on the car were Hugh McMillan, Frank E. Snow, Frank B. Rae, the inventor of the motor, and Mrs. Rae, Eugene T. Hill, General Manager of the Pumpelly Storage Battery Company, of Chicago, and S. M. Heavenworth, all of whom expressed themselves as greatly pleased with the trip. The storage batteries employed are those manufactured by the Pumpelley Storage Battery Company, of Chicago, and invented by Mr. J. K. Pumpelly, who has proved in this experiment the success which he has already looked for in this line, that is, a storage cell that will stand any rate of discharge without the plates buckling or being injured, and one that will stand the rough usage entailed by car service while capable of being charged rapidly with a very large current, a very important point in railroad traction work.

Perhaps the most practical trip made with the car was on Sunday, June 15th, when one of the motor cars of the overhead system was put aside and the storage car was placed on the track to do its work on the regular trips. The German picnic of that day crowded all the cars, and for all this the storage car made a trip of 52 miles with one charge of battery, carrying very heavy loads. There was no trouble in handling the car, and as far as the public were concerned it appeared no different from the regular overhead cars. In several of the experiments a speed of 16 miles per hour was reached, and 12 miles was a fair average, although, of course, such high speed was not permitted in regular traffic. Mr. Rae has certainly succeeded in making the single motor, adapted according to his own plans for traction work with storage batteries, a great success. In fact, it is stated, the car shows a better average of work for the weight carried in batteries than shown in any of the recent data given by Mr. Anthony Reckenzaun of European storage car fame. The car has been shipped to Middlesborough, Ky., where it will go into regular daily operation, having been ordered by the street railway company there.

Mr. J. H. Mason, of Mason battery fame, has been doing a rushing business for some time past, and during the last month or two there has been an enormous demand for the battery for light motor work. Several hundred fan motors, mostly of the Perret type have been put in all over the country to run fans or sewing machines. His employees, as a relief from their heavy work, have organized a Fourth of July excursion to West Point.

THOMSON-HOUSTON STATIONARY MOTORS.

The Thomson-Houston Electric Company have just issued a very neat and handy little pamphlet on electric power. It gives a variety of details as to the work done by their motors, and contains a number of interesting illustrations. The motors built are all of the upright, single magnet type. They are ordinarily shunt wound, and are built for constant potential circuits of 110, 220 and 500 volts.

In the tables below are given some figures on the weight, space occupied, etc., of the motors from one to seventy-five horse-power.

TABLE I.

Class.	H. P.	Pulley.		Width of Belt in inches.	Belt speed in feet per minute.	Approximate speed of Armature.
		Diam. in inches.	Face in inches.			
2	1	4	1½	1	2410	2300
3	1½	4	2	1½	2300	2200
6	3	5	3	2½	2620	2000
10	5	6	4	3	2830	1800
15	7½	8	5	4	3350	1600
20	10	8	6	5	3350	1600
30	15	10	7	6	3670	1400
40	20	13½	9	8	4600	1300
50	25	14	9	8	4400	1200
70	35	14½	10	9	4410	1170
90	45	15½	11	10	4570	1125
120	60	17	12	11	4540	1020
150	75	19	13	12	4180	900

TABLE II.

Class.	Weight in pounds.	Floor space of motor in inches.	Floor space (including sliding base) in inches.	Outside Dimensions (including sliding base) in inches.		
				Length.	Width.	Height.
2	145	16½×10½	23½×16½	19	23½	17⅞
3	300	20⅝×13½	28½×21⅝	24	28½	$24\frac{3}{16}$
6	480	25 ×16⅝	24½×25	29½	24½	$25\frac{5}{16}$
10	700	26 ×18½	30 ×26⅞	31½	30	$28\frac{7}{16}$
15	1080	31⅝×21½	33½×31⅝	37½	33½	$31\frac{9}{16}$
20	1364	34½×23⅞	37 ×35	40	37	32⅞
30	1950	37 ×27⅞	40½×37½	44	40½	36½
40	3160	47½×30½	50⅝×49⅝	58	49⅝	41½
50	—	— —	52½×62	62⅝	62	43
70	*5100	55½×36½	57½×66½	$67\frac{5}{16}$	66½	46
90	6350	63½×39½	65½×75½	76½	75½	50½
120	7050	66½×40½	69½×78½	81½	78½	54½
150	10000	73½×46½	76½×88	89⅝	88	63½

NOTE.—The motors of the higher classes, from Class 40 inclusive, are furnished with cast-iron sliding bases.

* Approximate.

ELECTRICIANS AT ASHEVILLE, N. C.

Asheville, N. C., is rapidly becoming the centre of a number of electrical enterprises, and as the key to a fine mountain region is attracting a great many electrical men, who hunt and shoot and fish. A corporation called the Western North Carolina Mining Co. has just been formed by several well known electrical engineers and has acquired a magnificent hunting territory on the Hogback Mountain. It is rich not only in game but in minerals of all kinds. Club headquarters have already been built on the property, and a large party have just been enjoying themselves there, among the number being Messrs. W. D. McQuesten, W. J. Jenks, L. Stieringer, S. E. Barton, E. F. Davis. The vice-president of the company is S. B. Eaton, and R. N. Dyer is one of the trustees. It is believed that the property will in time develop into one of great value; and in the meantime it is an ideal pleasure ground for sportsmen.

EUREKA TEMPERED COPPER FOR COMMUTATOR SECTIONS.

The Eureka Tempered Copper Co., of North East, Pa., have received the following excellent testimonial from the Card Electric Motor & Dynamo Co., H. H. Walter, general manager, of Cincinnati:—"In answer to your inquiry of the 21st, will say we are very much pleased with the tempered copper we have bought from you for our commutator sections. The sections have all been true to size and as far as we can learn are out-wearing anything we have before been able to get. Though the cost is considerably higher than the ordinary copper, we have about decided to use the Eureka Tempered Copper on all the dynamos and motors of our manufacture."

THE WALKER ELECTRIC CO.

This company is now busy filling a number of orders for the Walker meter which was described in THE ELECTRICAL ENGINEER of April 9. The latest design embodies a number of improvements which still further simplify the apparatus and make its readings accurate to the last degree. Thus a recent test made showed that the indications of the recording meter corresponded exactly to the records kept by an attendant who watched and recorded the indications of an ammeter in circuit. As the meter also indicates a drop in the voltage of the circuit, it forms not only a valuable check to the consumer but a guide likewise to the lighting company as to irregularity of the service, which can then be remedied. As announced in our advertising columns the company is now fully equipped to take orders for this meter.

THE STANDARD ELECTRIC SUPPLY CO.

The Standard Electric Supply Company has been organized under the laws of the State of Massachusetts, with a capital of $10,000. The officers of the company will be Mr. Wm. P. Fairbanks, president; Mr. W. C. Woodward, treasurer; and Mr. G. D. Haynes, clerk. The company have taken handsome offices and salesrooms on the first floor of the New England building, 180 Summer street, Boston, and have a floor space of over 5,000 square feet. They will carry a full line of all electric light and railway supplies, and will have a number of specialties which will be published later.

WATERPROOF AND INSULATING PAPERS.

The Standard Paint Company, of 59 Maiden Lane, New York, announce two new grades of building paper. One whose trade mark is the "Universal" is prepared with their P. & B. compound, is thoroughly water proof, acid, alkali and gas proof in all respects. The other new brand is called the "Giant" building paper. This paper is completely saturated with water proof, acid and alkali proof and insulating material, and the work is so thoroughly done that the paper can be cut in any way and torn into bits and no particle of it will absorb moisture. Every fibre is thoroughly impregnated. The paper is said to be more water proof than leather.

AN ELECTRICAL BLOCK SIGNAL.

An audible electric signal for railroads was tested last week at the One Hundred and Thirty-third street station of the Suburban Railroad. The power of the apparatus is furnished by an electric battery, which operates a relay in the railroad station. From this relay wires run to the railroad tracks, the joints of which are insulated with leatheroid. When one train is on a block of track protected by the contrivance and another enters, the engineer of the latter will be warned by the falling into sight of a flat iron disc painted a bright red and the simultaneous ringing of a gong. Both are parts of the signal box, which is arranged within the locomotive cab. They are operated by an electric current which is formed at the track joint along a wire, one end of which is attached to the body of the locomotive and the other to the front truck of the first car. The circuit is made as the locomotive wheels touch one rail at a magnetized point and the car wheels another. The invention is designed to be of special use in snow storms, fogs, and cases of color blindness. Twenty signals will be placed on the Suburban road.

THE "NICKEL-IN-THE-SLOT" PHONOGRAPH.

A nickel-in-the-slot phonograph is the latest novelty in the line of machines that are calculated to give some return for the moderate sum invested. There is only one of these machines at present in the city, says the *New York Times*, but a number of them will be placed shortly in the popular hotel lobbies, bar-rooms, etc., as well as in the railway waiting-rooms.

The working of this new machine is exceedingly simple, and the work done by the reproducing instrument is really wonderful, the sounds being so clear and distinct that it is only necessary to close the eyes to make one imagine himself in the actual presence of the musician. When the nickel is dropped in it releases a catch that holds a rod, the end of which is in plain view at the right of the upper portion of the case which carries the machine. By pressing this handle in as far as it will go the phonograph cylinder is set in motion, and then if the ear-pieces are placed in the ears the music is plainly heard.

The length of time the sounds are continued is regulated by an attachment that requires setting, and which is not automatic until set, when it is sure, however, to stop the music at the exact time required. When the nickel does its work it drops into a little receiver in plain view behind a glass, where it remains until the next nickel is dropped in, when it is pushed down to the safe, which stands in the middle compartment of the case. In this compartment will also be kept a number of spare cylinders, so that a constant change can be made in the tunes played whenever the proprietors of the instrument wish to do so. In the lower compartment is kept the battery which works the phonograph.

The appearance of the case, which stands about four feet high, is very neat, and would attract but little attention were it not for the glass top, through which the little machine and the nickel-worked attachment are plainly visible. On top of the case the words "automatic phonograph" explain what it is.

PERRET ELECTRIC MOTORS AND DYNAMOS.

The Elektron Manufacturing Co., 79–81 Washington street, Brooklyn, have just issued a very handy vest pocket brochure entitled: "Information about small electric motors and batteries." The subject of small power is taken up and discussed for the benefit of the uninitiated public, in a very clear, simple and forcible manner, and the various points about primary and storage batteries are all admirably explained. Various illustrations are shown of the Perret small motor attached to sewing machines, fans, &c. With this goes a fly sheet price list for motors, batteries, fans, guards, &c.

The company have also published a large sheet of testimonials not only as to their motors but as to their slow speed dynamos for lighting. Of one of the motors, a printing house in Philadelphia say: "We don't know how we could get along without it, and it could not be purchased from us for three times the amount we paid for it, provided we could not get another."

A NEW THOMSON-HOUSTON FACTORY FOR MINING WORK.

The Thomson-Houston Co. has secured the estate of John Welch, Berkeley street, Lynn, for which negotiations have been for a long time pending. By this purchase they will be able to run the spur track from the Saugus branch of the Boston & Maine R. R. as originally laid out to the shipping department in factory H, and thence to the new factory C extension, and the testing house now in process of erection on Federal street. A section some 20 feet long only remains to be built to connect factory H with the railroad.

The latest factory to be built has been named "Factory J." It stands on Centre street, and will be used for the manufacture of electric coal cutting machinery.

NEW ENGLAND TRADE NOTES.

MR. EDWIN R. WEEKS, and wife, of Kansas City, have been welcome visitors to the Hub, during the past week, and have been cordially received by their numerous friends in this part of the country.

MR. S. S. SIAS, treasurer of the Boston Electric Light Co., and wife, celebrated the 25th anniversary of their marriage Saturday evening, at their residence on Agassiz street, North Cambridge. The house was brilliantly decorated and illuminated, and a number of guests were present from Boston, Somerville, Brookline and Cambridge. The couple were recipients of many elegant gifts, among them an elaborate cathedral chime clock from the directors of the Boston Electric Light Co.

THE ELECTRIC GAS LIGHTING COMPANY are never behind hand, and their enterprising general manager is constantly on the outlook for good things, and no one knows better than he how to push them. The latest circular, got up in Col. Burnham's usual tasteful style, is one calling attention to the Gethins improved gravity battery, specially adapted to closed-circuit work. This battery only requires to be brought prominently before consumers to be used exclusively, as its good qualities will recommend it wherever used.

FRANK RIDLON & COMPANY, who seem to enjoy a monopoly in New England, of the second-hand electrical business, have been quite busy this month in furnishing second-hand motors and dynamos to all parts of the country. Mr. Ridlon has the happy faculty of not only finding out where second-hand electrical apparatus is wanted but, what is just as important, where it can be had. He reports the following sales:—one 25 light Ball arc plant; one 200 light "W. E.' Weston incandescent plant; one 30 light Brush arc plant; two Robinson Foster motors; one 2 h. p. Cleveland motor; six 7½ h. p. railway motors; three ⅛ h. p. Perret motors, and one Crocker-Wheeler motor. Mr. Ridlon has pleasant offices in the Estes Press building.

THE EASTERN ELECTRIC CABLE COMPANY, of Boston, are just completing additions to their factory which will give them facilities for 50 per cent. more machinery to turn out their famed Clark wire. Their sales this year have been enormous, and they are at present doing a business of over 70 per cent. more than for the corresponding period last year, having for the past few months kept two complete gangs of men at work, one in the night and one in the day time. Their "Hub" line wire, recently introduced has met with much success, and they are recently in receipt of a most flattering testimonial from the Buffalo Association of Fire Underwriters, who tested the wire for 93 days most thoroughly. The wire was immersed in salt water for 75 days, then it was allowed to dry for 28 days, immersed in salt water again for 24 hours, and tested with 1,500 volts with a delicate galvanometer and no deflection observed. No better guarantee of its thorough waterproofness could be given.

THE EVANS FRICTION CONE COMPANY, of Boston, are rapidly becoming recognized as furnishing a reliable system of frictional driving between engines and dynamos, and recently have been quite busy with all classes of work. By the use of their system, dynamos can either be driven direct from the engine or from countershafting when a large engine is used. They have recently been giving attention to equipping ship plants, as their system is specially adapted when only a limited space is available. On the S. S. "Portland," of the Portland Steam Packet Company, which is equipped with 400 lamps, they have installed their system on two "E. I." Thomson-Houston dynamos driven from the one fly-wheel of an Armington & Sims engine. The plant is situated on the keelson of the boat and occupies a total space of 7½ feet by 10 feet. The "H. M. Whitney," of the Metropolitan Steamship Company, which is equipped with a 200 light Thomson-Houston plant, with Armington & Sims engine, is also fitted with their friction system of driving, and the plant occupies a space of 4½ feet by 6½ feet. Messrs. Charles L Seabury & Company, yacht builders, of New York, are installing a Loomis plant to furnish one search light and 90 incandescent lights in one of their new yachts, to be driven by an upright engine, and the Evans system will be used. We have yet to learn of any failure in any of their installations, and the Evans system of driving bids fair to become very popular as it becomes more widely known.

WESTERN TRADE NOTES.

MR. "NED" FOX, the representative of the Phœnix Glass Company, is in town at the Tremont House. He intends remaining in the city for a couple of weeks. The Phœnix Company have recently produced some very fine novelties in their line.

THE PUMPELLY STORAGE BATTERY CO., 129 La Salle street, are showing some very handy surgical batteries, 2 cells in one case, for cautery purposes, weighing complete about 12½ lbs. and having a capacity of 25 ampere hours. These cells are readily and conveniently charged by a battery of 5 bluestone or other primary cells.

SHAY, STEPHENS & COMPANY will shortly remove from their present quarters at 154 Van Buren street, to new and larger premises on the West Side. This will enable them to carry a full line of samples, insulators, battery jars, electric light globes and all the various other specialties relating to their business. The company are replete with orders and are doing a very large and growing trade.

W. P. ADAMS & COMPANY have sold 3 compound non-condensing engines, aggregating 600 horse-power, for the new Edison South Side Central Station plant. This makes an aggregate of 1000 horse-power in all sold to this company in three weeks. During a month and a half's business this firm has sold engines to the extent of 2600 horse-power, thereby beating previous records. Mr. J. E. Wilson, the junior member of the firm, is still on the jump and, not even altogether satisfied with the present amount of business, is still looking and hustling for more.

MR. C. H. CONE, 108 Adams street, the well-known agent of the Findlay Glass and Carbon Co., of Findlay, O., has taken hold along with his other specialties of the Baxter motor, and will be the general Western agent for these machines, which are in operation everywhere and spoken of very highly by those who have used them. Both from Mr. Cone's great ability in this line and the excellence of the machine, a large business will be done; and the Baxter Electric Motor Co. could not have placed the task of pushing their motors in this section in better hands. Amongst numerous recent sales of batteries Mr. Cone reports the following: 1000 cells to the McIntosh Battery Co., Chicago, for medical work; 1200 cells to D. Fitzpatrick, Chicago; 500 cells to Miles & Hale, St. Paul; 500 cells to Novelty Electric Supply Co., Cincinnati, O.

THE WESTERN POWER CONSTRUCTION COMPANY have now got settled in their magnificent new offices in the Rookery Building, 144 Adams street The offices are furnished in a handsome and sumptuous manner, and, being located on the ground-floor, are very handy and accessible. This large corporation is the outcome of the well-known firm of W. P. Adams & Co., who, finding that their business was to be so abnormally great in handling the McIntosh and Seymour engines, have succeeded in interesting some prominent Chicago capitalists in an enterprise that bids well for success. They have, therefore, formed the above-named organization with a capital stock of half a million dollars, all of which has been already subscribed for. They have secured the agency for the famous McIntosh and Seymour engines from the Allegheny Mountains to the Pacific Coast, and as outlined in their prospectus, they are now prepared to make propositions for the complete erection of steam power plants in this territory, and where necessary, will also erect the building. Mr. Waldo P. Adams is the genial and experienced general manager of the new company and Mr. James E. Wilson, formerly representing the interests of J. A. Grant & Co. in the west will take a prominent position. They have also secured the services of Mr. Charles S. Colson, who has had an extended experience in steam engineering. They will be pleased to receive a call from their numerous friends.

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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, *150 Broadway, New York city.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

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What is there so real, what is there so enduring, what is there so useful, as a new idea so stated that it can be employed and lead to a useful practical result?—J. J. Storrow.

DEPTFORD.

FOR nearly two years the electrical profession has been kept in great uncertainty by conflicting rumors regarding the state of affairs connected with the big Ferranti station at Deptford near London. At one time the public was informed that the great 10,000 volt alternating machines had proved defective, and again, that the conductors laid had succumbed to the strain, so that, in consequence, current had to be transmitted at a reduced potential. These statements, going out unqualified, naturally had a tendency to cause the Deptford enterprise to be looked upon in the nature of a failure so far as the original plans of the designer were concerned. But when Mr. Ferranti announced his intention of building and operating machines and circuits at 10,000 volts, it is safe to say that he had maturely considered the undertaking; and the courage and enthusiasm which have thus far accompanied his work may possibly be traced to the touch of Yankee blood in his veins. Whatever may be the opinion as to the advisability of operating machines of the capacity employed by Mr. Ferranti, we think it is now conceded that there is no obstacle to their successful operation, the earlier defects being mostly due to imperfect construction which has since been remedied. But the nature of the circuit to carry 10,000 volts pressure involves considerations of perhaps a higher order even than those involved in the construction of the dynamo. In the latter we may reduce the potential at two contiguous points as much as we desire by increasing the number of coils and hence decreasing the difference of potential between them. Not so, however, with the conductors of the exterior circuit, which are subjected to the maximum strain at every point in their course. Those who are familiar with the difficulties of confining currents of but a few thousand volts to their proper channel will realize that the work undertaken by Mr. Ferranti was none of the easiest and that he deserves all the encouragement which can be accorded to a pioneer, for such he certainly is. The exact condition of affairs existing to-day at Deptford is well set forth on another page and is, we think, sufficient evidence that complete success will ultimately be attained. It will be observed that even now current is being transmitted at a pressure of between 5,000 and 6,000 volts over a temporary cable, and the results already obtained with the new type of Ferranti cable are of the most encouraging character. Our readers will no doubt be interested in the constructive details of the new leads, which exhibit, to the full, Mr. Ferranti's ingenuity. Every electrical engineer who has had the good fortune to inspect the works at Deptford, will admit that Mr. Ferranti has struck out on a new path with a confidence and ability that should carry him on to success.

AFTER OPERATING, WHAT?

THE New York *Sun* published recently an interesting article with the above caption, in which the assertion was made that one-third of the operators in the country are continually preparing themselves for other professions, while the other two-thirds are continually thinking about it. Coming to particulars, it says that of the 100 men working on the regular night force in the Western Union main office at 195 Broadway, 36 of them are either studying or working at something else in the day time, as follows:—Doctors, 8; lawyers, 6; ministers, 3; brokers, 3; actors, 2; theatrical managers, 2; real estate dealers, 2; inventors, 2; book agents, 1; manufacturers, 1; civil engineers, 1; authors, 1; commercial business, 1; electrical supply agents, 1; composer of music, 1. It is probably the fact that the telegraphic business soon loses its glamor for ambitious young men, and that thereafter they turn their thoughts to other fields, where promotion and riches are likely to be enjoyed sooner. But it is a little bit striking that the above classification of emigrants from telegraphy does not include a single student of electrical engineering. In the old days, it was from the telegraphic ranks that the best recruits for telephony and electric lighting were drawn; and it would seem only natural that more of the men seeking to cut loose and better their fortunes should perfect the electrical training they have already received. But it is not so. On the contrary, a large number of the new men coming into the profession either hail from the technical schools and universities, or are attracted from non-electrical fields, in which, as the result of special bent or taste, they have secured some kind of expert practical knowledge for themselves. A great many telegraphers become connected with electrical enterprises, but that is not exactly the same thing as becoming skilled electrical engineers, able to handle not only circuits, but knotty formulæ and modern steam plants, and all with equal ease.

THE GROWTH OF THE ALTERNATING SYSTEM.

It was practically not until the spring of 1887 that the alternating current incandescent lighting system came into commercial operation in this country. At the February meeting of the National Electric Light Association in Philadelphia it was described and discussed as a thing quite rare and novel and of dubious value. Looking over the list of central stations on their alternating system just issued by the Westinghouse Electric Company, we find a detail of no fewer than 301 central stations, of a total generating capacity of 554,350 lamps of 16 c. p. or 886,960 lamps of 10 c. p. This is an enormous growth, and, of course, does not by any means represent all the alternating plants in the country. But even if it stood by itself, this list would be evidence of amazing development and would show beyond cavil that the alternating system had found a vast territory awaiting occupancy by it, and had already made a respectable start in filling that territory up. On a basis of about $30 per 16 c. p. light, this growth represents the handsome investment of not far short of $17,000,000 in these 301 central stations, for lamps, wiring, dynamos and steam or water plant.

Electric Lighting in the South.

In a comment last week upon *Brown's Gas Directory*, we noted that the electric lighting companies were in the proportion of nearly two to one, to the gas companies. It would appear that in the New South the ratio in favor of electricity is much greater. For example, during the first six months of 1886, 1887, 1888, 1889, and 1890, the number of new electric light companies in that section was 17, 33, 80, 134, and 127; as compared with new gas companies, 15, 24, 18, 12, 16. In other words, the figures are 391 to 85, or a proportion of over 4 to 1 in favor of electricity. The explanation of much of this is that there has been a considerable upbuilding of new cities and towns in the South, and that, naturally, the electric light has been preferred. The same explanation applies to electric railroads, the preference being given to electricity in the large majority of new roads.

Ohm's Law.

The science of electricity, like most of the sciences, is based upon but few fundamental laws, and among these Ohm's is unquestionably the most important. Indeed it may be said that the majority of the others are more or less directly derived from it, forming corollaries applicable in many ways. A clear understanding of this law, therefore, such as can best be obtained by actual demonstration, is highly desirable to implant in the minds of students; and the simple method described by Prof. Mayer, on another page, will be appreciated by all lovers of experimental science. The account of the history of Ohm's law evinces the remarkable penetrative powers of Ohm and the clearness of his reasoning.

The Edison Underground System.

The "solid" underground systems that have been put in up to date have, so far as we are aware, been discarded and abandoned, with one exception, which stands in striking contrast as a brilliant success. That exception is Mr. Edison's tube system, of which we were enabled to give a very complete and interesting description, with many illustrations, in our last issue. No authoritative data has been available since the Franklin Institute reports of 1881–5, and while the system remains the same in essentials, it has naturally undergone various modifications and perfections of detail in the five years that have elapsed since then. Unless the behavior of the New York subways improves soon, there will be a choice only between some such system as this and the large open tunnel; although some of the leading subway experts say we would be in as much danger from gas explosions even with the tunnels as we now are with the "ducts." It may be noted, in passing, that the recent pamphlet issued by the United Edison Manufacturing Company contains a number of interesting testimonials as to work done with the Edison system at the other extreme—using overhead bare copper conductors.

Watering a Station Under Difficulties.

One of the features of interest and importance in the newer stations is the provision for water supply. Of course where the station is planted on the river bank, the superintendent is exempt from any thrill attendant upon a little "tank drama" of his own; but we have known of instances where the worry of maintaining water supply was enough to turn a man's hair gray in a night. One friend of ours had the blissful experience, when the city water works went wrong, of keeping up his water supply for several weeks by means of oil tanks which the railroad brought in daily from a distance. His fear lest those tanks should get side tracked, and his delight when the precious supply ran in safely on time can be readily imagined. By all means let stations provide against shortness of water.

Mr. J. P. Barrett and The World's Fair.

We print elsewhere in this issue a copy of the petition asking for the appointment of Mr. J. P. Barrett, the electrician of the city of Chicago, as director of the electrical department of the World's Columbian Exposition. This petition is most influentially signed, and, as will be seen, carries with it the approval of all the leading men and houses in Chicago. While the matter is not one that concerns Chicago alone, it is evidently one in which that city has a deep interest, warranting a step of this kind; and we believe that the nomination will meet with general acceptance. Mr. Barrett is a public official, without commercial alliances, and should, from his long, practical experience, prove himself to be just the man for the post. We hope the appointment will be made.

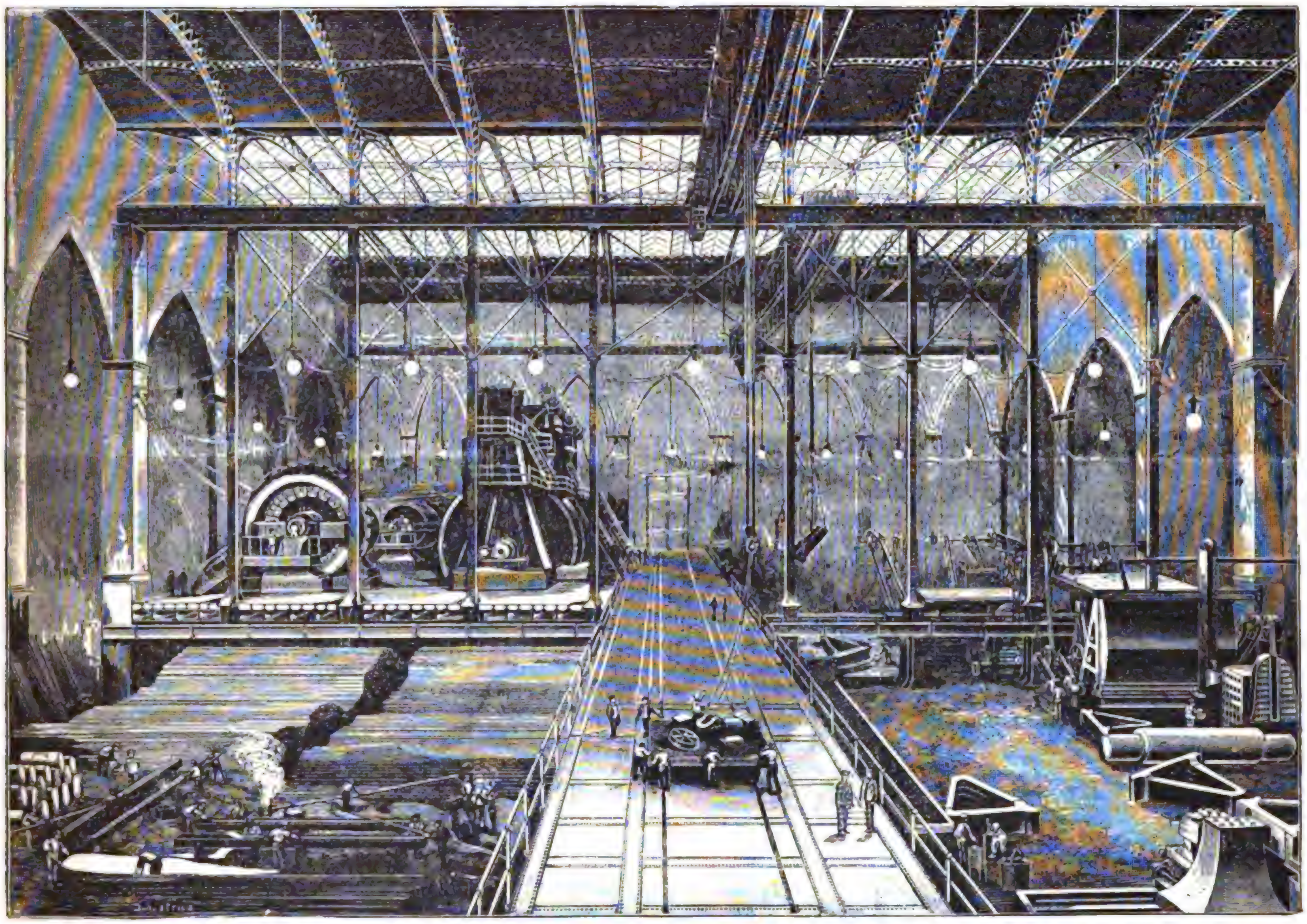
English Telegraphers.

Many of our American telegraphers are apt to imagine that a Government control of the telegraphs would bring them relief from all the unfavorable conditions under which they now labor. The state of affairs in England shows this idea to be unfounded. In fact, the telegraphers there are in a chronic condition of discontent, and just at the present time their feelings are so wrought up that they seem likely to go on strike again. It is even rumored that the authorities may send to America for men. Possibly there may be a few who would go, but if they did, it is hardly likely they would find America a pleasant country to live in on coming back.

THE DEPTFORD FERRANTI STATION.[1]

The Deptford station is, as is well known, anything but completed, as far as erection of the plant goes, but in one sense it may be said to have been complete before it was begun, because every detail was planned out with the greatest care and forethought before the actual work was commenced, and a description of this station now will probably give a fairly exact idea of what the finished station will be like, and will be more interesting to our readers, as the Deptford scheme is exciting so much attention at present.

The visitor on entering the building, which is illustrated in the accompanying engraving, is struck with its enormous size. At first one is lost in admiration of the pluck and enterprise shown in setting up business on such a scale, but the feeling is soon qualified by an uneasiness as to whether the pecuniary risk is not unnecessarily great in proportion.



INTERIOR OF THE DEPTFORD, ENGLAND, FERRANTI STATION.

The present position of the corporation as regards mains is this:—They have made and put down a mile or so of their own mains, but they are not in use. They have, therefore, to depend on the Fowler-Waring concentric mains. These mains are too small, and with the load now in use the loss over them amounts to over 1,200 volts. The outer conductor is only lightly insulated, and would not stand this, and the leakage all along the line from it to earth has given considerable trouble to the telephone companies. The corporation has therefore been obliged to use only the inner conductors of the cables, leaving the outer conductors idle. The action on the telephones due to the use of separate cables is avoided by crossing the leads frequently.

One engine and dynamo is now taking the Grosvenor Gallery work, and another engine and dynamo are ready for work. The cables now in use are Siemens' concentric for distributing mains at 2,400 volts, and Fowler-Waring for temporary trunk mains. The Ferranti concentric mains are being made, and about a mile has been put down, but they are not in general use yet. They have been officially and otherwise tested; by cutting through the outer insulation with a pick-axe until the outer conducting tube is exposed, it may be safely grasped in the hand, as might be expected. The joints are long cones, so that any leakage would have to pass along a considerable distance to get to the other conductor. No doubt the ozokerite will readily unite perfectly. In fact, ozokerite has, we believe, properties analogous to pure rubber, in the facility with which it will unite under pressure. A little warmth would certainly unite it. In this point vulcanized rubber is inferior. It will never repair a leak in its substance, whereas pure rubber, and probably ozokerite, will.

It has been said over and over again that the Deptford scheme is a wild experiment, and is more or less certain to end in a dismal failure which will do incalculable harm to the industry generally. The first novelty is transmitting electrical energy at 10,000 volts. This is simply a question of insulation, but that is no small matter. The whole question of insulation for very high electromotive forces is very obscure. It would seem quite likely that it is not a question of the maximum difference of potential between the two leads—in this case two concentric tubes—but of the rate of fall of potential; that is to say, the difference of potential between the faces of each little element of insulation. For instance, we can easily imagine that india-rubber will stand a stress of say 1,000 volts per millimetre, so that a large sheet one centimetre thick would stand 10,000 volts. In this case all the portions of the rubber have to stand equal stresses. But if the rubber is

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wrapped round a cylindrical conductor, the inner layers will be subjected to a greater stress than the outer; and if the stress is near the maximum, thickening the coat of insulation can do little good. The rate of fall of potential depends on the diameter of the cylinder, so that the larger the conductor, the easier it is to insulate it so as not to break down. On the other hand, the larger the conductor the lower the insulation resistance measured in megohm miles, so that we have the paradox that a small conductor which shows a high insulation resistance may be more likely to break down than a large one with a comparatively low insulation resistance taken in megohm miles.

Then, again, there is the question of insulation conductivity; it may, or may not, follow that a material which conducts slightly, is liable to break down. It is most probable that a dielectric breaks down suddenly, and that a microscopic conduction has nothing to do with this. If that is the case, insulation resistance measurements give no indication as to safety against breakdowns, except in so far as they localize an incipient fault.

Returning to the Deptford trunk mains, there seems to be no reason why 10,000 volts is not practicable, especially with a conductor an inch in diameter; but great difficulty may be expected in the joints, even when coned, and especially if expansion and contraction have any chance of working the joints. We would again suggest that the difficulty may, perhaps, not be in making the joint to give a high insulation resistance, but in arranging it so that the fall of potential over the insulation is always gradual. The problem is, in fact, analogous to designing a static electric machine so that it has no corners to form discharge points. Ozokerite is tougher and more elastic than paraffine wax, and does not seem to develop minute cracks on solidifying.

THE FERRANTI MAINS.[1]

AMONG electrical engineering enterprises at the period of early development of the industry in England, the large central high-tension system at Deptford will remain noticeable, not only on account of the largeness of its conception, but also on account of the remarkable difference of opinion and statements of fact which have arisen about it.

We must first of all remind our readers that the scheme at Deptford comprises two engines of 1,500 h. p. and two engines of 10,000 h. p., driving Ferranti 10,000-volt alternate-current dynamos for transmission of current through mains to London, and transformation there to currents of

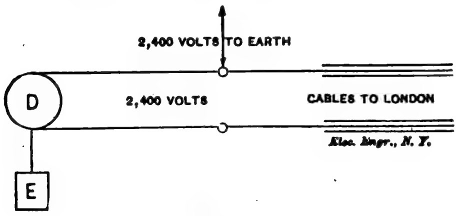

FIG. 1.

2,400 volts, as for some years distributed from the Grosvenor Gallery. Of these engines, one of the 1,500 h. p. engines is erected and has been running since November, last year. This is the only engine running at Deptford at present. A second one is already erected, but is not yet used for supply, and two 10,000 h. p. dynamos are in course of construction, and parts of the immense 42ft. flywheels, the 27-ton shaft, and the huge cranks are being turned up in machine tools erected inside the station.

It will be remembered that the Ferranti concentric mains not being ready, the company laid and ran from Deptford to Charing Cross temporary cables of special manufacture. These, however, were found to be unable to stand the high pressure of 10,000 volts, and a reduction to 2,500 was made, the inner conductors only of the two cables being used.

At this pressure current was transmitted for some time from Deptford to the Grosvenor, where it was used together with the current from the Grosvenor dynamos. The arrangement under these conditions is shown in the diagram, Fig. 1. It is hardly necessary to remark that such an arrangement reduced by half the output that could be transmitted at even the half pressure before used of 5,000 volts, and at this lower pressure the whole lighting of the present installation of 38,000 lamps could not be supplied from Deptford.

An ingenious arrangement was therefore adopted and has been running for some weeks, by which, though the

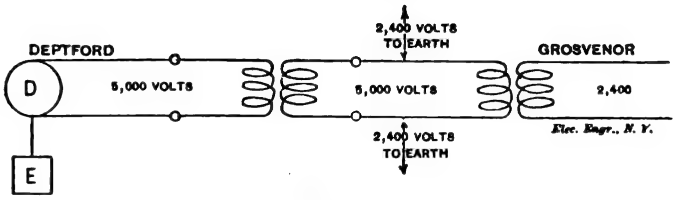

FIG. 2.

pressure to earth from the cables is only 2,400 volts, yet the total pressure of the current transmitted is 5,000 volts, under which conditions the whole lighting can be, and has been, done from Deptford, the Grosvenor acting merely as reserve. This arrangement, which will doubtless greatly interest our readers, is shown in diagram in Fig. 2. The Deptford dynamo is run at 5,000 to 6,000 volts, and one pole of the dynamo is put to earth. But instead of transmitting direct to the Grosvenor, the current is put through transformers *at Deptford*, transformed and transmitted to

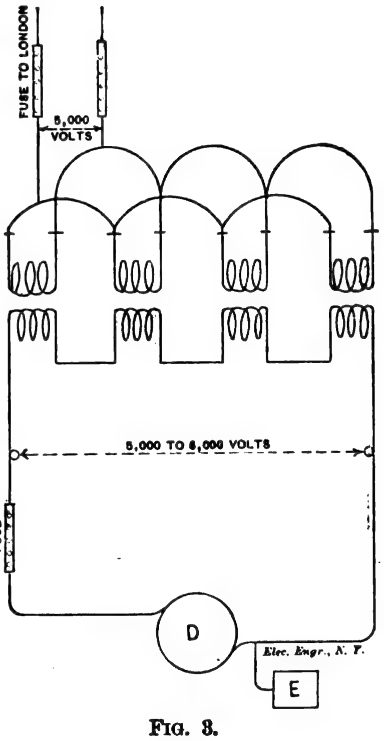

FIG. 3.

London still at 5,000 to 6,000 volts. Now, as will be seen by the diagram, though the total pressure between the mains is 5,000 volts or more, the difference of potential between each of the cables and earth (the insulation being kept the same in both) is exactly what it was before in the case of one only—viz., 2,400 or 2,500 volts. In this manner the danger of sparking to earth is overcome, and double the energy is transmitted.

The exact arrangement of the transformers is indicated in diagram Fig. 3. Four transformers are arranged with

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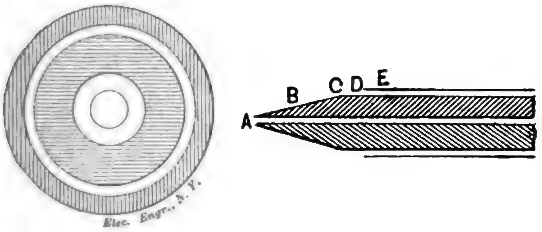
their low-tension coils in series in the dynamo circuit with a high-tension fuse on one pole, and the other dynamo pole being put to earth. On the other side of the four transformers their poles are connected in parallel, passing through two high-tension fuses, and so into the main cables to London. So that each set of four transformers transforms from 5,000 to 6,000 volts, with three fuses in circuit, and one pole on the dynamo side of the transformer being to earth. Three sets as above are arranged at Deptford, each set with its own main switch and three fuses, so arranged that one, two, or three circuits can be thrown in at will, according to requirements at London as intimated by telephone.

These diagrams are reproduced from those kindly given to us by the company's engineers.

Accurate records are kept from day to day and from



FIGS. 4 AND 5.

hour to hour of the current and pressure registered. The amounts now registered in daily running show currents of from 30 up to 120 amperes at pressures from 5,000 up to 6,000 volts. This, it will be observed, is already nearly two-thirds the pressure of 10,000 volts ultimately intended to be run. The main laid was originally intended for this higher pressure with a loss in transmission of 8 per cent. The current, as at present sent, is at half or two-thirds only of this, and, of course, the loss in transmission is naturally somewhat higher at the lower pressure. But it

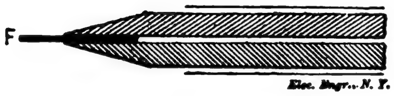


FIG. 6.

is interesting to note that, notwithstanding this extra loss at present, the actual cost of manufacture per unit delivered at London from Deptford is stated by the engineers to be considerably less than the cost of manufacture at the Grosvenor.

For the manufacture of the Ferranti concentric mains special machinery has been erected at Deptford, and is now in full working order. Some two miles or so of main are

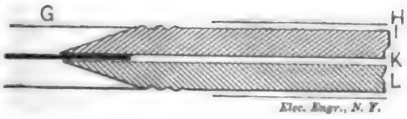
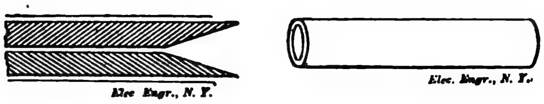


FIG. 7.

now being turned out every week, and on our visit we were shown the entire process from beginning to end.

The main is of section shown in Fig. 4; first, a small thick hollow tube of copper; then the main insulation; over this the outer hollow conductor of thin copper tube; then another thin coating of insulation; and, lastly, a steel outer casing for prevention of mechanical injury.

The first process is that of insulating the inner conductor. Copper tube of the required section (¼ square inch area) and size is cut off by a circular saw to a length of 20ft. This is taken to a long tressel and long strips of brown paper, 20ft. long and some 4ft. wide, are gummed at one edge to the copper tube. This is now taken to the covering machine. This insulating or covering machine has been specially designed and adopted for the manufacture of these mains, and works with great ease and simplicity. At one side another machine prepares specially coated paper. This machine is nothing more than a long hot-plate, coke-heated almost to the scorching point, over which long strips of brown paper, from huge rolls like that



FIGS. 8 AND 9.

used in printing newspapers, are drawn by rollers. On the hot-plate all moisture is driven out, and the strip of paper then passes down, into, and through a hot cauldron of special black oil or wax, coming out soaked in this wax, and is then dried and cut off into 20ft. lengths. These lengths are carried to the insulating machine first mentioned, and laid in heaps underneath a long metal table in front of this machine. The copper tube is slowly rotated, and six or seven sheets are then wound on till the inner tube is covered as thickly and tightly as possible.

The next process consists simply in slipping this 20ft. length of insulated tube into a second hollow tube of thin copper, which forms the outer conductor, and which is of corresponding total section to the smaller and thicker inner

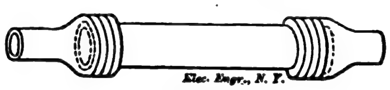


FIG. 10.

one. Then the whole is passed through a large draw plate, and the outer tube is carefully drawn down tightly over the insulation.

Next, the insulating process is repeated on the larger conductor—gummed brown paper, inserted sheets of prepared waxed paper, hot wax bath, rolling, and taping.

Finally, the first stage of the manufacture is completed by slipping on the exterior protective casing of thin steel tube. In this steel tube a small hole is drilled in the center previously, and through this hole hot wax or bitumen is forced in by a force pump, driving out all air at both ends, and forming a compact and solid mass.

Next comes the most important and interesting part of the manufacture of the Ferranti mains, the construction of the joints. When we remember that some six or seven miles of this cable are to be laid in each main; that three mains will be laid from Deptford to London at once, and

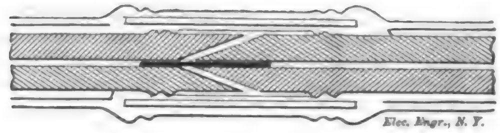


FIG. 11.

that a joint comes every 20ft., it is evident that the joint is the point at which greatest care must be taken to have perfect insulation and perfect protection against creeping or sparking of the 10,000-volt current.

The joint is made in the following neat and simple way: First, the cable, as manufactured in lengths, is taken to specially adapted turning lathes. There one end of the main is turned carefully and smoothly down in a taper of 6in. length, from the centre conducting tube backwards to the outer conducting tube, as shown in Fig. 5. This turning is carefully and accurately done to gauge, and by tools set at the required angle, and is polished off to a smooth surface.

The interior of the inner copper conductor is accurately bored out and smoothed; and then a length, some 18in. or so, of turned solid copper rod is forced into this, a tight

metallic fit, as in Fig. 6. Then a sleeve of thin copper tube, slightly larger than the outer conductor, is slipped over the end of this outer conductor, left bare for several inches for the purpose, and is there corrugated down upon it with three corrugations, as shown in Fig. 7. This corrugation is an essential part of the construction of the Ferranti main, and is a neat, simple, and effective method of securing both good metallic contact and strong mechanical juncture. The method of corrugating on is carried out with a smooth polished steel wheel and grip, and it is used, as will be seen, several times in the making of the joint. This finishes one end of the length. The end is filled up

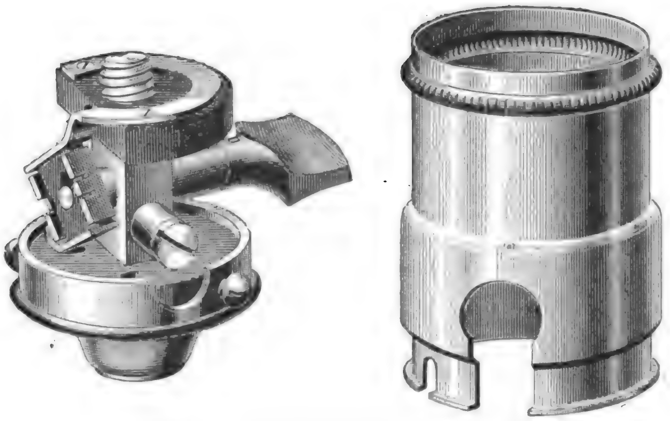


FIG. 1.—THE "H. G." KEY SOCKET.

with a piece of greased waste, and capped with a tin cap ready for transport by railway.

The other end is treated in a corresponding way to form an exactly opposite contour, into which the end of the next length can be pushed tightly. The insulation here is turned out in a hollow coned or taper form from the exterior inward for the length of 6in., as shown in Fig. 8. This turning is also carefully done with tools set at the required angle and smoothed or polished, and the ends meant to join are tested together to see that they fit.

The main is now ready for actual jointing. In making the joint the ends are pushed together, the solid inner rod, which projects from one end of each length, going into the interior of the inner conductor of the next length. Previously to the jointing, a joint-cover, composed of two pieces, Figs. 9 and 10, is slipped some distance back over the main. This joint-cover comprises a sleeve or tube of waxed paper insulating material, and a length of steel tubing formed like a reducing junction, as shown in the figure. To make the joint the ends are pushed together as mentioned, and then are forced together by hydraulic pressure till tight home. The joint is now heated, and the smooth taper surfaces of the joint stick together. After this the copper sleeve, which has now slipped forward over the joint, is corrugated down in the manner before explained upon the other side of the main outer conductor. thus forming metallic connection with this outer conductor, When this is accomplished the paper insulating sleeve, with the exterior steel protecting piece, Fig. 10, are slipped forward over the joint. Hot wax or bitumen is forced in to fill up the space, and finally each end of this steel jointing piece is corrugated down upon the steel protecting tube of the main itself, so forming a compact solid joint.

Thus the joints are made. About two-thirds of a mile of this main has been laid and practically tested since April 19. Pressure of 16,000 volts to 18,500 volts have been kept on this length, at intervals as the dynamo has been running, ever since. Since then fresh lengths have been added from time to time, each length being tested as it was put on with 18,500 volts. No breakdown whatever has occurred, even in testing. The actual working current has not actually been passed through at this pressure, owing to the evident difficulty of getting rid of, or absorbing, this enormous energy. But this length of main has been tested with 400 amperes of current at a low pressure, and immediately after this test the full testing pressure of 18,000 volts was turned on with equally satisfactory results. One part of the main, where it entered the Deptford works, has been twisted and bent into wavelike form to show that bending can be done without damage to the cable ; and also to test this method of allowing for expansion without the necessity for special expansion joints. We shall await with impatience the actual working of these mains to London, but it will be seen that the particulars we have been able to give show great promise of a satisfactory method of dealing with the enormous tensions with which Mr. Ferranti has associated his name at the Deptford central lighting station.

THE POLARIZATION OF ELECTRODES.

THE maximum polarization which metallic plates acquire when plunged in an electrolyte varies with the temperature ; when silver wires are used the variation is very regular, and tends towards zero as the temperature approaches that of the decomposition of the salt. M. L. Poincaré has investigated this matter by changing the nature of the electrolyte on the one hand and on the other by using electrodes of different metals. With different electrolytes it is stated that the polarization of the silver is nil at the temperature of decomposition. In substituting wires of gold or iron for those of silver the polarization has not the same regularity, but the final result is the same. It is therefore concluded from the experiments of M. Poincaré that the polarization of electrodes is nil at the temperature of the decomposition of the electrolyte.

A NEW INCANDESCENT LAMP SOCKET.

In the accompanying engravings we illustrate a new incandescent lamp socket invented by Messrs. A. B. Holmes and G. T. Gale, and known as the "H. G." socket. This socket, which is manufactured by the Consolidated Electric Manufacturing Company, of Boston, is extremely simple in construction and is said to contain fewer parts than those generally in use. The electrical and mechanical features have also been well worked out.

In the key socket, shown in Figs. 1 and 2, the contact springs are of phosphor bronze. They are broad and are cleaned by the working of the key in turning the light

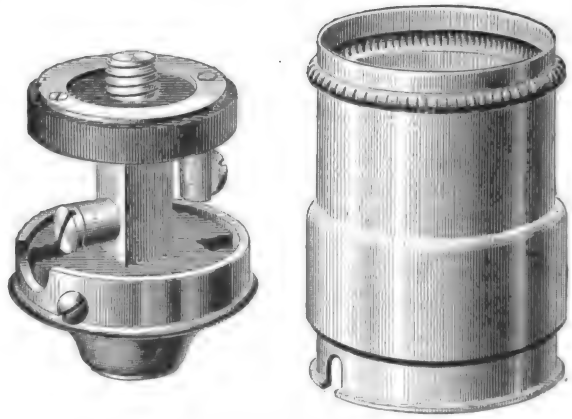


FIG. 2.—THE "H. G." KEYLESS SOCKET.

either on or off. The springs are of ample carrying capacity and make perfect contact with the connecting block. In a test lately made at the factory of the company the socket was used as a switch and would make and break the circuit carrying current for twenty-six 16 c. p. 90 volt lamps, without heating.

It will be noticed that the key is constructed so as to give a double break, thus ensuring an absolute rupture of the circuit.

The engravings, Figs. 3 and 4, illustrate the new keyless socket manufactured by the same company, which is so simple as to require no further description.

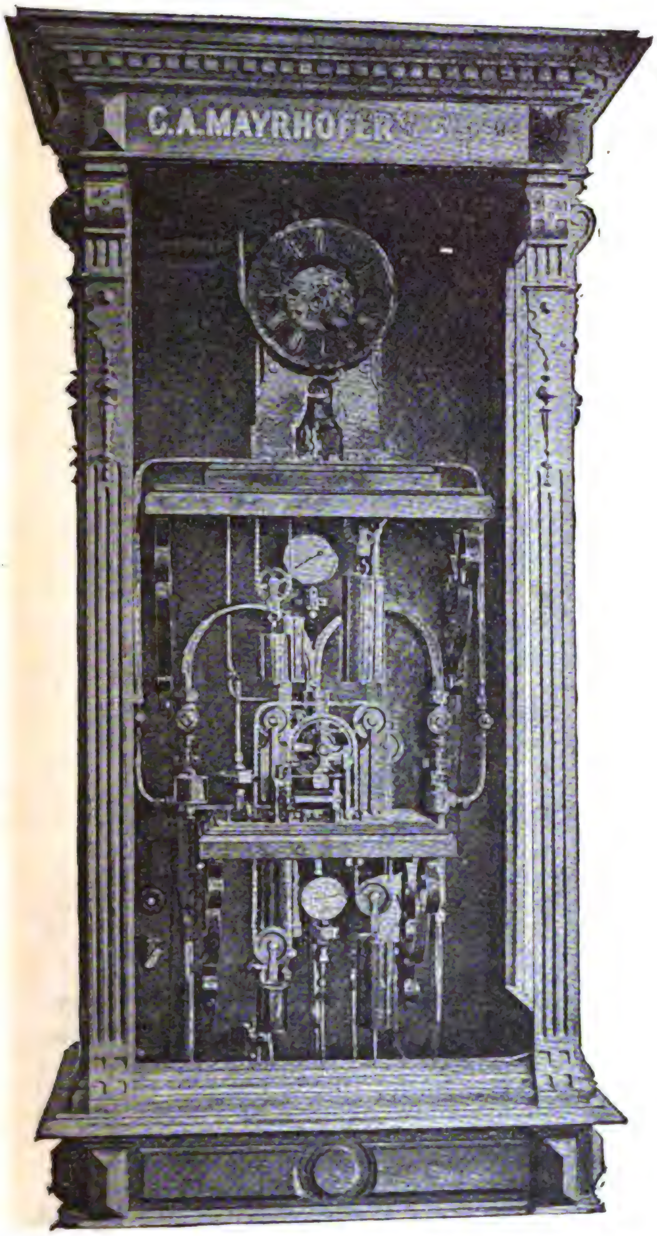
THE MAYRHOFER ELECTRO-PNEUMATIC TIME SYSTEM.

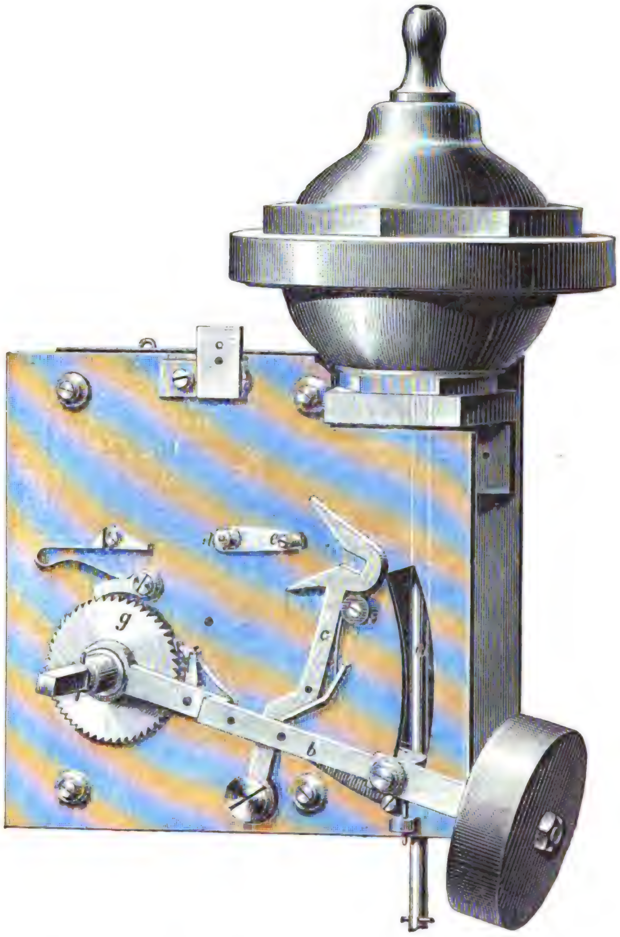
The distribution of accurate time over a large area has long been the subject of study, and not a few inventions have been the outcome of the desire to accomplish this result. The adaptability of electricity for this purpose seems obvious, and it has been employed in various ways. But we desire now to bring before our readers a system in which electricity is combined with a pneumatic system in which the results obtained have thus far proved highly satisfactory. This system, known as the Mayrhofer electro-pneumatic system for distributing standard time, is now being introduced in this city, having been in use a number of years abroad with eminent success. The system consists of a central apparatus with a master clock, or regulator, and a series of secondary clocks which are connected with the central apparatus by a system of tubing. Our illustration, Fig. 1, shows the central apparatus and the master clock.

The master-clock or regulator is in electric connection with the central apparatus, and opens at certain intervals of time, say, every half hour or hour, the supply-cock of a main pipe by which water is supplied to ejectors which are connected to the line pipes, and which produce a vacuum in the same, which vacuum is made use of for winding up and setting all the secondary clocks in the system. The connection between the master-clock and the mechanism for opening the supply-cock is made by an electric circuit which is closed at regular intervals, so as to operate an electro-magnet, the armature of which releases the driving mechanism of the supply-cock.

These clocks are each provided with an oscillating lever, *b*, Fig. 2, that is connected by a spindle with a diaphragm, located in a hermetically-closed casing or shell, which is connected to the line-pipe; so that by the lifting of the diaphragm by the vacuum produced in the line-pipes, the actuating lever is raised, and a hand-setting fork *c* operated, which engages a crank-arm *e* on the arbor of the minute-hand, so as to set the hands, while a pawl and ratchet-mechanism, operated by the main lever, winds up the spring or weight of the clock so as to enable it to run in a regular and reliable manner until the next re-winding takes place.

The system is capable of operating 500 secondary clocks from one central apparatus, which can be placed in any portion of the building for which the time service is arranged. The apparatus, it will be noted, is entirely automatic in every respect, and requires no attention whatever, owing to the joint action of the electric, hydraulic, and pneumatic forces. The clocks being of the ordinary construction it is evident that if, for any reason, the water supply should fail or an accidental break in one of the small tubes should occur, the secondary clock will continue to run until the cause of the accident is removed and the defect repaired. This system, we may add, has been successfully introduced into a number of public buildings in Vienna, in the new Stock Exchange, and the Potsdam railway station and other buildings in Berlin. We may say that the full plant is in working operation in Aldrich Court in this city at the present time, where a large number of secondary clocks are distributed in the offices.



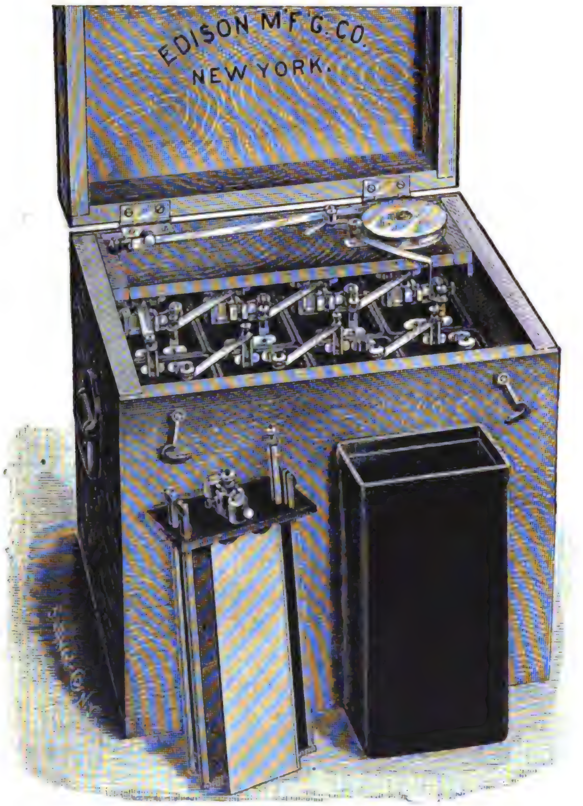


FIGS. 1 AND 2.—THE MAYRHOFER ELECTRO-PNEUMATIC TIME SYSTEM.

THE EDISON—LALANDE BATTERY FOR CAUTERY PURPOSES.

The use now made by physicians and surgeons of electric current and electric appliances is so extensive as to warrant special effort in adapting apparatus to their necessities, especially where it is evident that a number of advantages can be gained. Such is the case with the Edison-Lalande Battery which has now been brought out in a form that renders it peculiarly suitable as part of a medical cabinet or outfit. In this battery, it will be remembered, the elements employed are zinc as the positive and the black oxide of copper as the negative, the exciting liquid being a solution of caustic potash. The chief qualities of the cell are its low internal resistance and its great constancy, rendering it available equally for both open and closed circuit work.

The cell is made in various sizes, and 8 of these cells are taken and put together in hard rubber cases in a neat oak box standing 16½ x 15½ x 13 in. In this shape the battery is very handy and convenient for medical use, answering the requirements of both a portable and a stationary set.



EDISON-LALANDE CAUTERY BATTERY.

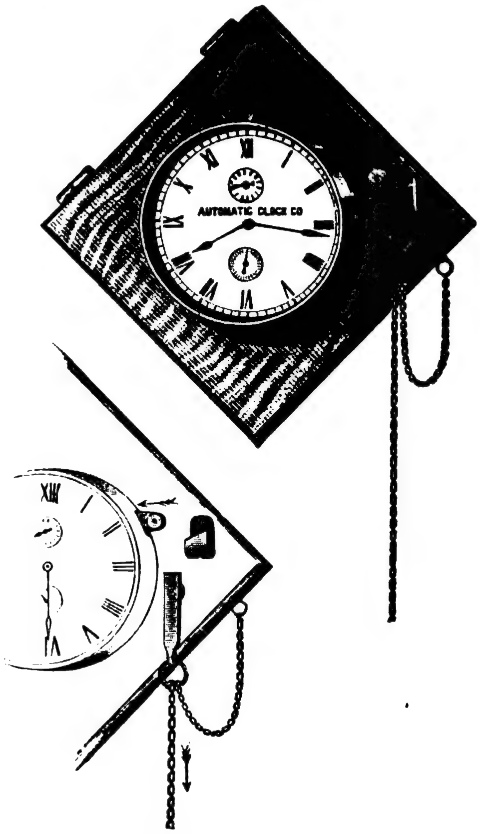
The resistance is included in the outfit, and is placed in a very novel manner in the top of the case, on a little hinged lid that can be thrown up so as to expose all the batteries clearly to view. This resistance is in the shape of metallic tape, and operates after the manner of a fishing reel or ordinary yard measure. It is pulled out to any length as required, and when the needed resistance is obtained is held at that point. As the battery falls off, it can be released and rolled up automatically, either all at once, or gradually.

As is well known the usual cautery knife requires a considerable volume of current to keep it at white heat—say 15 or 20 amperes. This the Edison-Lalande cautery battery will supply steadily for 7 or 8 hours without flagging. Even then it will not be exhausted but will give forth sufficient current to maintain the ordinary cautery made at proper heat for a great many hours.

THE AUTOMATIC SWITCH CLOCK.

In many instances in connection with electrical work it is necessary to switch on current to various devices at a set time, or to break the circuit. Thus in the operation of arc or incandescent lamps in stores usually no provision is made for turning out the lights at the hour of the evening agreed upon in the contract, and it is left either to the consumer, or, more frequently in the case of the arc light, to a lineman who turns out the lamps. But, as station managers know to their cost, the lights are not infrequently allowed to burn all night, for which the company gets no revenue whatever.

In order to get rid of this source of loss and relieve the customer as well as the company of the care of switching off lamps at the proper time, the Automatic Clock Co., of Syracuse, N. Y., have recently brought out a simple and ingenious arrangement which effects this work automatically.



FIGS. 1 AND 2.—AUTOMATIC SWITCH CLOCK.

The apparatus which is illustrated in the accompanying engraving, Fig. 1, consists of an ordinary clock with a small attachment. The motive power for operating the switch consists of a roller with a chain attachment, hung on an inclined track a little to the right of the clock and kept in place by a bar drawn from the clock and resting against the track. At the set time the bar slides into the clock, as shown in Fig. 2, and then, the track being clear, the roller drops, and operates either to open or close a switch, as the case may be.

The uses to which this simple device can be applied must be apparent. It can be employed not only in turning on and off lights but may be used also in connection with motors, etc. Another use for it is found in connection with the regulation of furnaces. Thus it may be so set as to keep the damper of a furnace closed during the night but effect its opening at a fixed time in the morning so as to warm the apartments before the rising of the occupants, and at the same time awaken the servant by closing the switch of an electric bell circuit. Many other uses will suggest themselves to our readers and the clock seems well adopted to afford convenience and effect increased economy in various directions.

THE "UNIVERSAL" ELECTRIC LIGHT FIXTURE SWITCH.

We illustrate on this page the new "Universal" electric light fixture switch just brought out by the Bergmann Electric and Gas Fixture Co., of this city, intended for all kinds of electric light fixtures, and for any system of incandescent lighting. Fig. 1 shows the switch by itself; Fig. 2 shows one manner of applying it, and gives an idea of its internal construction.

Electric light fixtures have been made hitherto without this almost indispensable appliance, and have consequently been inferior to gas fixtures in the important respect of convenience in turning on and off the light. Moreover, the best made and most ornate key sockets of any electric light system are but too often unsightly, and will disfigure the fixtures on which they are used, if these fixtures make any pretensions whatever to design and ornamental character. In fact the application of this "Universal" switch has even opened the way to some new designs hitherto impracticable or unthought of because of its absence. The key socket not being used, and the keyless sockets having been reduced to much smaller and ornamental shapes, a great gain is accomplished in the direction of style and appearance, as well as cheapness, convenience and practical qualities of fixtures.

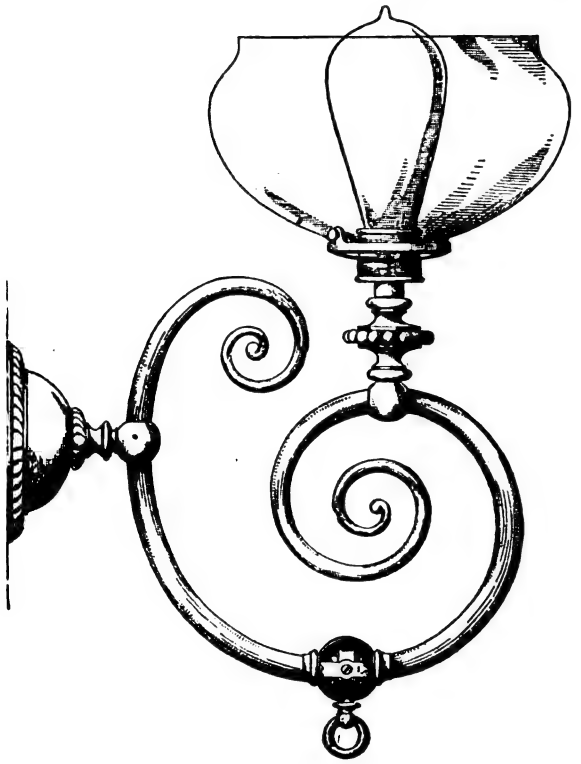


Fig. 2.—Fixture with "Universal" Switch.

To have the key for turning on and off the current in the lamp socket itself, is to have it, in nine cases out of ten, in the most inconvenient and inaccessible position. The lamp socket is generally high up on the fixture, and a special key turner is often necessary, not only because the key is beyond ordinary reach, but because it projects sideways, or at an angle, instead of downward. The tendency at the present time is toward making the lights point upward, as in gas fixtures, and where they point downward to inclose the lamp (and often the socket itself) entirely in the globe. This can only be done in a practical manner by embodying the switch in the fixture itself.

The "Universal" switch will, in most cases of course, be used for but one light, but it will easily do for several. It may be pointed out that the switch and connecting parts are separate from the supporting frame, which can be cemented, soldered or brazed into the fixture, and undergo every process that fixtures are put through during their manufacture, affording at the same time as strong and substantial a support of the parts of the fixture as a regular gas cock. The key shown in Fig. 2 is separable, and other patterns can, of course, be used as desired. The key gives a clean, quick make or break and turns either way.

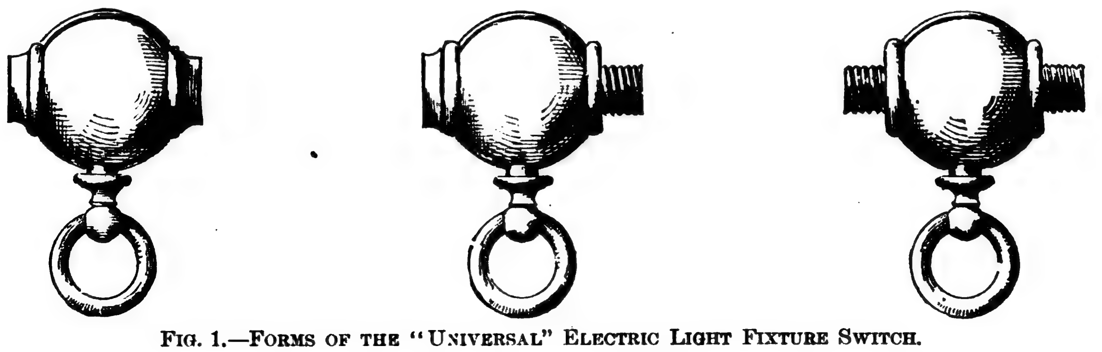


Fig. 1.—Forms of the "Universal" Electric Light Fixture Switch.

THE KOUSMINE DIFFUSION BATTERY.

The diffusion battery of M. Kousmine, which was shown at the recent Galvano-Plastic Exhibition at St. Petersburg, has been much used in Russia. By making use of the phenomenon of diffusion M. Kousmine has succeeded in overcoming the increase in internal resistance of the bichromate of potash battery due to the formation of crystals on the positive electrode. The positive carbon electrode consists of four strips attached to the lid of the battery. The negative zinc electrode consists of a circular grating, resting on the bottom of the battery. By means of a funnel a 15 deg. Beaumé solution of sulphuric acid is introduced, until it just reaches the lower end of the carbon strips. A 6 to 7 per cent. solution of bichromate of potash is next introduced. The two liquids do not mix on account of the great difference in their densities. When the battery is short-circuited it is easy to see that chemical action only takes place close to the lower end of the carbon strips, which are gradually surrounded by a violet ring 2 or 3 millimetres deep. Above this region the bichromate solution retains its original color. The bichromate solution being very weak, the chromic crystals dissolve as soon as they are formed, and the positive electrode is not covered by a deposit, as in other batteries. The solution of these crystals, having a greater density than the surrounding liquid, falls to the bottom. The sulphate of zinc also falls to the bottom of the cell, causing more sulphuric acid to rise. A cell having the following dimensions was tested by a committee of experts at the exhibition in question:—Height, 20 cms.; diameter, 15 cms.; surface of zinc, 176 sq. cms.; bichromate solution, 6 per cent.; sulphuric acid, 15 deg. Beaumé. The committee reported that after having been circuited for 8½ hours on an external resistance of .32 ohm, and then left on open circuit for 10½ hours, the cell continued to work for 4½ hours, when the circuit was again closed, and that it gave during 13 hours 36 ampere hours for an expenditure of 48 grammes of zinc.

THE PORTER AUTOMATIC ENGINE FOR ELECTRIC LIGHTING.

While the well known appliances for keeping down the coal consumption in electric light plants are well recognized, the most important factor, after all, is the steam engine itself. It is in this part of the plant that economy is obtained by the close regulation of the steam consumption to the load on the dynamos, and at the same time economy of operation in the dynamos and outside circuit by maintaining constant speed.

To effect these necessary attributes of a successful electric light plant, the Porter M'f'g. Co., L'td., of Syracuse, N. Y., have designed the automatic engine illustrated in the accompanying engraving, Fig. 1. In this engine special attention has been given to economy, perfect regulation of speed and simplicity and rigidity of parts.

The distribution of steam is effected by a single flat slide valve perfectly balanced with a cover plate, and so arranged that water may escape from the cylinder without injury to the engine.

For the regulation of the engine the Porter company have adopted the wheel governor of the Straight Line Engine Co., designed by Prof. Sweet, which gives perfectly uniform speed under a varying load and steam pressure. As shown in the accompanying engraving, Fig. 2, it consists of a single ball linked to the eccentric and spring, and so located and weighted as to counterbalance the eccentric and its attachment, and it controls the speed of the engine in the following way: When the speed of the engine reaches the point where the centrifugal force of the governor ball overcomes the resistance of the spring, it flies out, and in doing so moves the eccentric nearer the shaft, shortens the travel of the valve and reduces the amount of steam admitted to the engine. The ball is made of malleable iron, cast hollow, and loaded with lead or shot.

Being heavy and being located at a considerable distance from the centre of motion, and running at a high velocity, the ball has great centrifugal force, and requires a strong spring to resist it, thus forming a powerful governor. In the construction of the governor the aim has been to reduce it to the fewest number of pieces and have it balanced, and to make it very strong and free from friction. It takes no more power to run it than it would so much weight added to the fly wheel, and the engine cannot run away from any other cause than the breaking of the governor ball, as the breaking of the spring would stop the engine. A variation of from five to ten revolutions may be effected by putting in or taking out shot from the hollow ball.

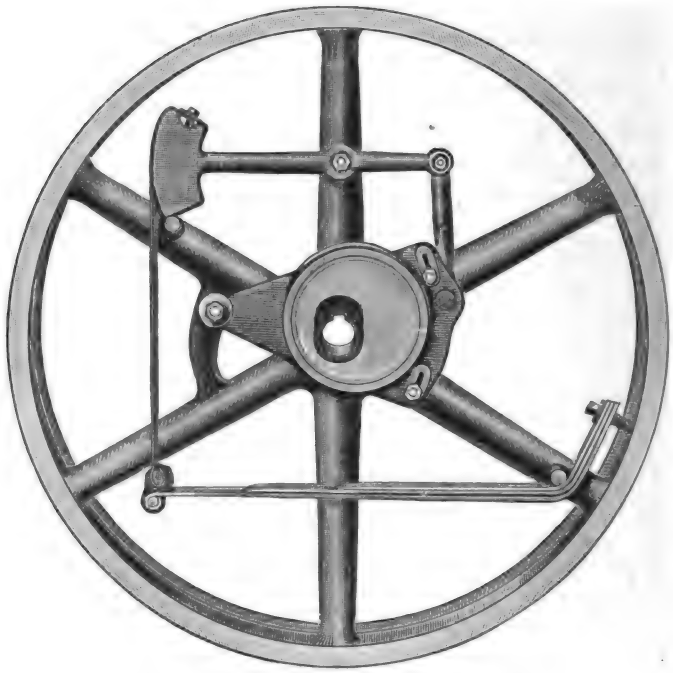


Fig. 2.—Governor of Porter Engine.

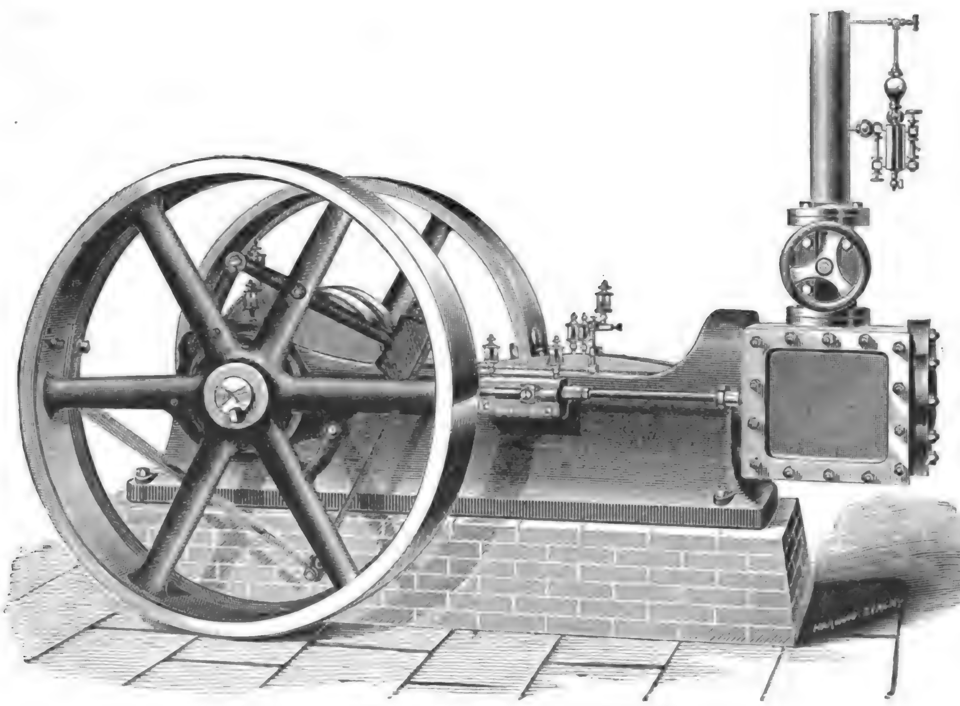


Fig. 1.—The Porter Electric Light Engine.

These engines are at present built in sizes ranging from 23 to 82 h. p., and all designed to run at a speed of 300 revolutions per minute.

The Cause of the Explosion.—In an article on the recent volcanic eruptions at Broadway and Fulton street, the *American Gas Light Journal* says that it is all "because of the infernal recklessness of the Steam Heating Company."

AN EXPERIMENTAL PROOF OF OHM'S LAW—PRECEDED BY A SHORT ACCOUNT OF THE DISCOVERY AND SUBSEQUENT VERIFICATION OF THE LAW.[1]

BY PROF. ALFRED M. MAYER.

I PURPOSE giving in this paper a simple and direct experimental proof of Ohm's law, $\left(C=\frac{E}{R}\right)$. Generally a more formal statement of this law with illustrations are given in text books on Physics, and the student is left to infer that its truth is shown by the cumulative evidence given by the immense number of quantitative relations in electrical actions which the law associates, and by the experience that deductions made on the basis of this law agree in measure with the results of experiments. The latter fact is certainly one of the best proofs of the truth of the law; but, nevertheless, the relations between C, E and R are not directly and simultaneously shown to be exactly expressed by $C=\frac{E}{R}$. It is true that some works give experiments to show this relation, but they are so difficult to perform by reason of the difficulty of maintaining constant C, E and R, that the results of the experiments only approximate to those required by the law.

Ohm was led to the conception of this law by *assuming* that the flow of electricity in a voltaic circuit is similar to the flow of heat by conduction in a rod of indefinite extent. Also, his assumptions that the actions of two electrified particles are directly as their distance and that the electricity is uniformly dense over each cross section of a conducting wire were directly opposed to the laws and facts well established by Coulomb for statical electricity. It is not surprising that scientific men were slow in adopting the views and theory of Ohm. In his memoir (Die galvanische Kette mathematisch bearbitet von Dr. G. S. Ohm: Berlin, 1827) he states:[2] "Three laws, of which the first expresses the mode of distribution of the electricity within one and the same body, the second the mode of dispersion of the electricity in the surrounding atmosphere, and the third the mode of appearance of the electricity at the place of contact of two heterogeneous bodies, form the basis of the entire memoir, and at the same time contain everything that does not lay claim to being completely established. The two latter are purely experimental laws; but the first, from its nature, is, at least partly, theoretical.

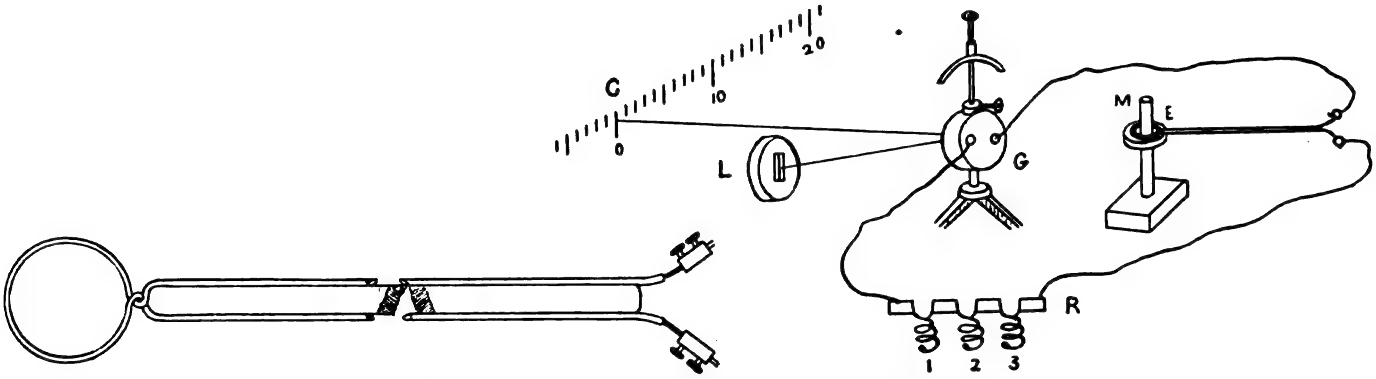
"With regard to this first law, I have started from the supposition that the communication of the electricity from one particle takes place directly only to the one next to it, so that no immediate transition from that particle to any other situate at a greater distance occurs. The magnitude of the transition between two adjacent particles, under otherwise exactly similar circumstances, I have assumed as being proportional to the difference of the electric forces existing in the two particles; just as in the theory of heat, the transition of caloric between two particles is regarded as proportional to the difference of their temperatures. It will thus be seen that I have deviated from the hitherto usual mode of considering molecular actions introduced by Laplace; and I trust the path I have struck into will recommend itself by its generality, simplicity, and clearness, as well as by the light it throws upon the character of former methods.

"With respect to the dispersion of electricity in the atmosphere, I have retained the law deduced from experiments by Coulomb, according to which, the loss of electricity in a body surrounded by air, in a given time, is in proportion to the force of the electricity, and to a coefficient dependent on the nature of the atmosphere. A simple comparison of the circumstances under which Coulomb performed his experiments, with those at present known respecting the propagation of electricity, showed, however, that in galvanic phenomena the influence of the atmosphere may almost always be disregarded. In Coulomb's experiments, for instance, the electricity driven to the surface of the body was engaged in its entire expanse in the process of dispersion in the atmosphere; while in the galvanic circuit the electricity almost constantly passes through the interior of the bodies, and consequently only the smallest portion can enter into mutual action with the air; so that in this case, the dispersion can comparatively be but very inconsiderable. This consequence, deduced from the nature of the circumstances, is confirmed by experiment; in it lies the reason why the second law seldom comes into consideration.

"The mode in which electricity makes its appearance at the place of contact of two different bodies, or the electrical tension of these bodies, I have thus expressed: When dissimilar bodies touch one another, they constantly maintain at the point of contact the same difference between their electroscopic forces (potentials).

"With the help of these three fundamental positions, the conditions to which the propagation of electricity in bodies of any kind and form is subjected may be stated. The form and treatment of the differential equations thus obtained are so similar to those given for the propagation of heat by Fourier and Poisson, that even if there existed no other reasons, we might with perfect justice draw the conclusion that there exists an intimate connection between both natural phenomena; and this relation of identity increases, the further we pursue it. These researches belong to the most difficult in mathematics, and on that account can only gradually obtain general admission; it is therefore a fortunate chance, that in a not unimportant part of the propagation of electricity, in consequence of its peculiar nature, those difficulties almost entirely disappear."

From these premises, and guided by results of experiments made by him and by Ritter, Erman, Jäger, Davy and Becquerel he arrived at the following conditions as existing in a voltaic circuit.



APPARATUS FOR EXPERIMENTAL PROOF OF OHM'S LAW.

1. In a homogeneous conductor, forming part of a voltaic circuit, the difference of the electric tensions at any two points of the conductor is proportional to their distance.
2. In different conductors forming part of a circuit, the difference of tensions at two points separated by an interval equal to the unit of length is in the inverse ratio of the section of the conductor and of its coefficient of conductivity. Hence, in different conductors, equal differences of tension correspond to lengths whose electric resistance is the same.
3. At the point of contact of two different conductors, there is a sudden variation of electric tension.
4. If A equals the sum of the electromotive forces, L the resistances, λ the resistance reckoned from a point m of the circuit to a point p when the tension is zero, the tension at the point m is given by the formula,

$$u=A\frac{\lambda}{L}.$$

Ohm eventually arrives at the formula $S=\frac{A}{L}$, which expresses what is generally known as his law. Which formula, he says, "is generally true, and already reveals the equality of the force of the current at all points of the circuit; in other words it may be thus expressed: The force of the current in a galvanic circuit is directly as the sum of all the tensions, and inversely as the entire reduced length of the circuit, bearing in mind that at present by reduced length is understood the sum of all the quotients obtained by dividing the actual lengths corresponding to the homogeneous parts by the product of the corresponding conductivities and sections."

The words "tension" (*Spannung*) and "electromotive force"

1. *American Journal of Science.*
2. See translation, published in vol. ii, of Taylor's Scientific Memoirs, p. 402, London, 1841.

used by Ohm are the equivalent of the word *potential*. He was the first to introduce this conception into the theory of the voltaic circuit and to the above words and to *current* and *resistance* he attached precise meanings and showed the relations existing between those quantities. The clear definitions Ohm gave of these terms marked a transition from vague ideas of "quantity" and "intensity" to the clear conceptions of potential, electromotive force, current and resistance. The word *energy* he also used with clear and accurate meaning as is shown in the following statement: "That the decomposing force of the circuit is in direct proportion to the energy of the current, and moreover, that it depends on a coefficient, to be derived from the nature of the constituent parts and their chemical equivalents." This was published in 1827, six years before Faraday's researches on electrolysis.

Neither Ohm nor his contemporaries were able to test the truth of the four statements given above as embodying Ohm's theory. It was reserved for Kohlrausch in 1849 to show by very ingenious and accurate experiments that Ohm's statements were true in mode and in measure. Kirchhoff [3] and Quincke [4] applied with success Ohm's theory to the flow of electricity in thin conducting plates, or bodies of two dimensions, and the same was done by Smaasen [5] not only in a plane but in bodies of three dimensions. The most remarkable confirmation of Ohm's law was made in 1876 [6] by experiments, suggested by Maxwell and performed by Chrystal in the Cavendish Laboratory, Cambridge, "in which the testing of this law seems to have been carried to the limit of experimental resources."

Though Ohm's law has thus received such ample verification that it ranks with the best established laws of nature, yet, as Maxwell says, "Ohm's law must, at least at present, be considered a purely empirical one. No attempt to deduce it from pure dynamical principles has as yet been successful. * * * The conduction of electricity through a resisting medium is a process in which part of the energy of an electric current, flowing in a definite direction, is spent in imparting to the molocules of the medium that irregular agitation which we call heat. To calculate from any hypothesis as to the molecular constitution of the medium at what rate the energy of a given current would be spent in this way, would require a far more perfect knowledge of the dynamical theory of bodies than we at present possess. It is only by experiments that we can determine the laws of processes of which we do not understand the dynamical theory."

Surely if an experiment, that is easily made, shows the truth of a law of such theoretical and practical importance as that of Ohm, even if it is one restricted in its range of C, E and R, but shows within its limitations the relations $C=\frac{E}{R}$, then it should be made by all teachers of physics so that clear physical conceptions of those relations may be given to students. As those who have seen these experiments have deemed them worthy of being more generally known, I now publish an account of them.

In the diagram, Fig. 1, the parts of the apparatus are shown, but not at their relative distances apart or in the proper proportions as to size. G is a low-resistance Thomson-galvanometer. At L is the condensing lens of a lime-light lantern, which is covered with a cap having a rectangular opening it. Across the middle of this slit is a vertical wire. The scale of the galvanometer is at C, distant 165cms from the mirror of the galvanometer. The width of the divisions on this scale are 2·5cms, and the lines are drawn 2·5mms in breadth, or $\frac{1}{10}$ the distance apart of the centers of the lines forming a unit of the scale. The scale is at such distance from the galvanometer-mirror that the image of the vertical slit just fits in the space of a scale unit, while the breadth of the image of the vertical wire is exactly equal to the breadth of a scale line. This arrangement gives the means of observing a deflection of the beam of light to $\frac{1}{10}$ and $\frac{1}{20}$ of a unit with quickness and accuracy.

The image of the slit is so bright and that of the wire so distinct that this method of observing deflections of the galvanometer may be used in broad day light and the deflections may be read throughout the room.

An incandescent electric lamp with a part of its surface (behind the plane of its filament) silvered may replace the lime-light. Thanks to this arrangement, I have been able during many years to make before my class electrical measurements, and to measure the radiation, reflection, refraction, diathermancy and polarization of radiant heat.

At M is a magnet 25cms long and 1¼cms in diameter. On this magnet slides a wooden disc. At R is box containing 1, 2 and 3 ohms of resistance, made of coils of copper wire.

An insulated copper wire wound at its middle in a circle of one coil, or in a spiral of any number of coils is placed over the magnet and rests on the top of the wooden disc. Fig. 2 shows (one-half size) how this circle of one coil is made. It is bent around a wooden cylinder 3¼cms in diameter, and then the free ends of wire are bent one-half turn on each other. The free lengths of the wire are then lashed to a light square rod of wood, as shown in figure. The wire and rod are then coated with shellac to cement them firmly together. Rings of spirals of 2, 3, 4, 5 and 6 coils are also made in the same manner, but the coils are in spiral, *i. e.* in one plane, and are then cemented together with shellac between rings of thin card-board.

The length of wire forming each of these rings of spiral coils with the portion on its handle is one meter long.

The resistance of this length of wire added to the resistance of the lengths between it and G and R, together with the resistance of the galvanometer is (for convenience) made one ohm.

It may be well here to speak of the adjustment of the galvanometer before describing the experiments, for I have noticed in some laboratories and lecture rooms galvanometers which are used not as they should be. I have noticed that the damping-magnet formed a considerable angle with the plane of the coil. This was either because the medium plane of the coil was not in the magnetic meridian or because there was considerable torsion in the suspending thread.

In these galvanometers, or, at least, in mine, the median plane of the coil is placed parallel to the faces of the drum of the instrument. The plane of one of these faces is brought in the magnetic meridian of the room, which has been carefully drawn on the table under the vertical center line of the galvanometer coil, by means of a long magnetic needle mounted like those used on plane-tables. A line at right angles to this meridian is now drawn so that its point of intersection with the meridian line shall be exactly under the suspending thread of the mirror. In the vertical plane of the line, drawn at right angles to the meridian, is placed the vertical wire in the slit of the lantern, L, and also the zero line of the scale C. The scale is parallel to the magnetic meridian. The galvanometer is now placed in the position given above and the "directing magnet" removed to a distance. The image of the vertical wire at L will now be found on the zero of the scale if there is no torsion in the suspending thread. If it does not come to zero then the head of the rod to which the thread is attached is turned till image of wire coincides with zero of scale, and then the instrument is in adjustment, and it will give deflections as the tangents of the strength of current, or, in other words, the current strength will be directly as the readings on the scale. The magnet M is now placed so that it causes no movement of beam from the zero of the scale. The directing magnet, above the coil, is now so adjusted that the time of an oscillation of the magnet of the galvanometer is above five seconds.

The coil, E, over the magnet is put in the circuit of G and R. The wires between E and G and R are twisted and tied together so that no induced current from the earth's magnetism may be caused by the motions of this part of the circuit. The image of wire is on zero of scale. Now on rapidly lifting the coil from around the magnet a deflection is produced by the magneto-electric current thus generated. It is sufficient to know that the cause of this current is the quick lifting of the ring with one coil. If we replace this by a ring of two coils we get twice the deflection, and rings of 3, 4, 5 and 6 coils give 3, 4, 5 and 6 times the deflection given by the ring with one coil. Adopting the conception of the lines of magnetic force, we say that the ring with one coil cuts a certain number of these lines, this cutting of the lines causes the current, and is *the electromotive force*. The ring with two coils makes two cuts of these same lines, or, cuts double the number of lines, the rings of 3, 4, 5 and 6 coils cut 3, 4, 5 and 6 times the number of lines and hence give 3, 4, 5 and 6 times the electromotive force.

In these experiments the resistance of the circuit has remained constant. Now take the ring with 5 or 6 coils and let us have one ohm as resistance of circuit. On lifting ring from magnet we get a certain deflection, which we may make exactly equal to a whole number of the units of the scale by sliding up or down the disc on the magnet. We now take out plug of resistance box and make the resistance of the circuit two ohms. The deflection of the galvanometer magnet now becomes one-half of that of previous experiment, and successively making the circuit with resistances of 3, 4, 5, 6 and 7 ohms we get $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{6}$, and $\frac{1}{7}$ of the deflection we got with one ohm in circuit.

When these experiments are made with the galvanometer in perfect adjustment, and with the precautions indicated below, the deflections arrive one after the other exactly as the law requires; thus showing with sufficient precision for a lecture experiment that the current is directly as the electromotive force and inversely as the resistance. Indeed generally the closest scrutiny does not detect in the scale reading any departure from the law.

Certain precautions are, however, necessary in these experiments. The resistance outside the galvanometer must be of copper wire, for such is the wire of the galvanometer. Also, the whole of the apparatus must be put together the day before we make the experiments, and the room maintained at as constant a temperature as possible, so that the temperature of all parts of the apparatus is the same. The deflections should not exceed 15 divisions of the scale. Thus, if we start with 15 divisions of deflec-

3. Pogg. Ann., t. lxiv, 1845, and t. lxvii, 1846.
4. Pogg. Ann. t. xcvii, 1856.
5. Pogg. Ann. t. lxiv, and t. lxxii.
6. Brit. Assoc. Rept., 1876, p. 36.

tion for a resistance of one ohm we will get 7.5; 5; 3.75; 3; 2.5, and 2.143 deflections for resistances of circuit of 2, 3, 4, 5, 6 and 7 ohms; and if with a constant resistance we obtain a deflection of 2 divisions of scale with a ring of one coil, we will get deflections of 4, 6, 8, 10 and 12, with rings having 2, 3, 4, 5 and 6 coils.

It is necessary that the coils should be removed from the magnet *very quickly*, otherwise the deflections will not be as the law requires. In other words, the currents produced should be as instantaneous as can be obtained. Instead of rapidly removing the coils by the hand, I have sometimes lashed the coil and their handles to a spring-board with a hole in it which went over the magnet. By a trigger this spring-board is released. We thus get the same velocity in lifting the coil in each experiment. We have found, however, that the hand of a good experimenter gives precise results. Sometimes I have sent the coil from the magnet by the blow of a stick delivered on the under side of the handle of the coil at its center of percussion. There is no doubt some departure from the law in these experiments, for it is not possible in such experiments to obtain what is understood by instantaneous currents; and the damping of the magnet by the mirror acting on the air must come into play. Yet I have never seen any but insignificant and barely discernible departures from deflections required by the law. This follows from the small angles of deflections and low velocity of the motion of the galvanometer magnet in the experiments. It is also to be noticed that with a good magnet of the size stated, and with the galvanometer making one vibration in about 5 seconds, the coil with 5 turns passes over only 2 cms., or less, of end of magnet in order that it shall give a deflection of 15 divisions of scale. It is evident that in these conditions a very short time is occupied in cutting the lines of force. If the maximum deflection used is 15 divisions of the scale, the actual angular deflection of the magnets and mirror amounts to only 6°29'. Yet 15 divisions is quite a length on the scale, being equal to 37.5 cms. But these experiments may be as readily made with a ballistic galvanometer. Then the magnets and coils have to be of larger dimensions.

Experiments similar to those given have served to graduate galvanometers. We have here the means of sending definite amounts of currents through an ordinary galvanometer and we may thus graduate its angular reading into their relative values in current. The damping of the galvanometer has, however, to be applied to the readings, and then the results may best be put in the form of a curve.

Stevens Institute of Technology, Hoboken, N. J.

ELECTRIC LIGHTING IN THE RAILROAD SERVICE.[1]

BY M. B. LEONARD,

Superintendent of Telegraph, Chesapeake and Ohio Railway.

For many years one of the most prolific sources of injury to railroad men and loss to the company has been the switching of cars in the yards at night, with only a hand lantern to indicate the movements required. The engineer, owing to the darkness, was obliged frequently to depend more on luck than otherwise to guide him in handling his engine, the result being often a crushed hand or shoulder for the brakeman, if he escaped being caught between the bumpers; or, the engineer miscalculating his distance in the darkness, would come back too hard, and thereby break the drawheads, and smash in the ends of the cars.

The introduction of the arc light in the large yards where a great deal of switching or making up of trains at night is performed, was found, as had been expected, to work a wonderful improvement in this direction, and the use of the arc light for this purpose is now so widely extended, that there is scarcely a railroad from the Atlantic to the Pacific, which does not use the electric light in its important yards.

An extended inquiry among the men using these lights develops the general belief that they pay for themselves several times over in the single item of repairs saved to rolling stock, by enabling the engineers to do the switching more carefully, and with less damage to the cars. These arguments seem strong enough to warrant the use of electricity for this service, whereever the business is large enough to require night work. Other important features in the use of the electric arc lamp, are the greater amount of loading or unloading of cars that can be carried on at night, than with the oil lamp system, and the reduction of the number of car robberies and shortages in freight packages.

The experience of the Chesapeake and Ohio Railway Company at its Newport News, Va., terminus, affords an excellent illustration of the benefits of the electric light in these respects. Through its connections with the Old Dominion Steamship line from New York, large quantities of freight are transferred to cars at Newport News for western points. As the New York steamers arrive at night generally, it is important that the freight be at once loaded, billed and forwarded with the utmost dispatch. Under the old oil lamp system it was found impossible to get the freight billed and cars loaded and started within less than twelve to fourteen hours after the steamer's arrival. The number of claims for shortage and damage were very great, and reports of freight astray were numerous.

In the hope that this condition of things might be improved, a fifty arc light plant was put up, and the piers illuminated by electricity. Immediately a new order of things prevailed; freight was billed and loaded correctly; there being no dark corners, the shortages and damage claims began at once to diminish, and the trains were forwarded in nearly one-half of the time it formerly required, while a substantial rebate was made by the insurance companies from the premium hitherto paid, which offset not a little of the cost of the electric plant, and the reduction of the premium goes far towards paying the cost of maintenance and operation at present.

The lighting was extended to the immense coal piers of the company, and the coaling of steamships, which up to that time could be done very slowly, and only at great hazard during the night, was rendered almost as easy as in day-light. It is therefore safe to say that the Chesapeake and Ohio are satisfied with their investment, and that their experience is not exceptional, is evinced by the fact of the Pennsylvania Railroad Company using no less than eighty arc lights on its coal wharves, yards, engine houses and depots in the city of Philadelphia.

While arc lights are usually designated as of 1,200 or 2,000 c. p., experience has shown that an arc lamp will give more light in some directions than others, and that while the use of globes very much diminished the intensity of the light, in certain cases they distributed it very much better.

For these reasons it is very difficult to determine just how many lights are necessary to illuminate a certain amount of space; frequently, therefore, the best results could only be determined by a number of trials of the lamps in designated positions, changing them about until the desired results are obtained.

A series of experiments, outlined in the *Railroad Gazette*, were recently instituted in Germany to ascertain the candle power of arc lamps, in which it was found that in a Siemens differential lamp, supplied with a current of 14 to 15 amperes at from 48 to 52 volts, the horizontal intensity was about 196 candles (German, very nearly the same as the English); it increased rapidly to about 20 degrees below the horizontal, where it was 1,150 candles, then more slowly until it reached a maximum at about 42 degrees below the horizontal plane, where the light was 2,014 candles; it then began to sink rapidly until below 60 degrees there was no light, but only shadow. The average intensity was 1,228 candles, with the globes on; the actual light obtained, ranged from 510 candles downward to 1,183 in a direction inclined 40 degrees below the horizontal, with an average illuminating power of 834 candles when freshly whitened reflectors were used.

In this country the best results seem to be obtained from the 10 ampere long arc, or from 40 to 50 volt lamps set on poles 35 feet high, and from four to six hundred feet apart. The clear glass globes give the best illumination, as but few of the light rays are absorbed by the glass, but it is found that the unshaded glare of the arc is very trying to the eyes of the trainmen, and consequently the half ground globes are preferred.

In examining the systems used, it is found that the Thomson-Houston and the Brush are most preferred, though the Western Electric and the Jenney are very popular in the West, while the new alternating system of arc lighting of the Westinghouse Company, owing to the greater life of the carbon, is making rapid strides.

A new and important improvement has recently been made in arc lamps which results in an enormous increase in the luminosity of the arc, and consequently a most brilliant and economical light. This has been effected by making the lower carbon hollow and fitting it with a reservoir of oil and a wick; the oil ascending the wick by capillary attraction is converted into carbon vapor by the heat of the electric arc re-inforcing the light of the arc by luminous particles of incandescent carbon, thereby increasing its brilliancy. The tests of this lamp recently made by Dr. Hopkinson, of London, show that the efficiency of the arc in watts per candle is nearly doubled, the color of the light being changed to a clear yellowish white, while the increased cost of the hollow carbon and the oil is so small that it is not worth mentioning—a single drop of the oil lasting nearly a minute. It is claimed for this new lamp that it reduces the cost of arc lighting to such an extent that it is equal to gas at ten cents per 1000 feet. Very little or no alteration is required to utilize this improvement in the present styles of arc lamps, and it is confidently expected that its adoption will soon become universal.

ELECTRIC LOCOMOTIVE HEAD-LIGHTS.

In still another direction the arc lamp will probably prove of great value to the transportation departments of our railroads. For several years experiments have been carried on with the view to adapting the arc light for use in the head-lights of locomotives. It was quickly ascertained, however, that the constant vibration of the locomotive seriously affected the feeding mechanism of the lamp, and consequently the brilliancy of the arc;

1. Abstract of a paper read at the 9th Annual Meeting of the Association of Railway Telegraph Superintendents, Niagara Falls, N. Y., June 19, 1890.

but recently the improved feed apparatus and the adoption of a copper negative pencil, instead of the carbon hitherto used, have been found to eliminate the difficulties, and the National Electric Locomotive Head-Light Company of Indianapolis is now ready to furnish head-lights of this description, the current being generated by a small combined dynamo and engine, carried on the locomotive. The engine is about three horse-power and has four cylinders; with the dynamo, which is about 2000 watts capacity, it weighs about 700 pounds, and is placed over the smoke arch of the locomotive between the head-light and the smoke-stack.

The trials of this apparatus made last November on the Vandalia line showed that on very dark and rainy nights, the fences to the cattle guards could be seen three-quarters of a mile away; a light-colored car would show as an obstruction on the track at about that distance, while one of dark color would not plainly be seen more than half a mile off; twelve telegraph poles would be plainly visible, while a white mile post would appear as a spot of light half a mile away. At 800 feet a tie at the side of the track would be plainly shown. Horses and cattle would show up clearly 1000 feet ahead, and the colors on a switch target could be seen a quarter of a mile distant.

This shows that any serious obstruction on the track, except in case of very thick fog, could be plainly distinguished far enough ahead to stop an air-braked train travelling at a speed of 45 miles per hour, while at a reduced rate of speed during heavy storms and freshets, the liability of running into open draws, or into trestles or bridges carried away by high water would be greatly reduced.

Another method has been experimented with to some extent, in which groups of incandescent lamps are placed in the head-light; this has given good results, but the beam of light is not as penetrating as when the arc is used, and the carbon filaments in the lamps are soon broken on account of the vibration of the locomotive.

THE ELECTRIC LIGHT IN SWITCH STANDS.

On May 30th, 1887, the Southern Pacific Railway Company, owning and operating its own electric light plant at Oakland, Cal., comprising a horizontal slide valve engine, locomotive boiler, and a 65-light, 10 ampere Brush dynamo, finding it difficult to keep the oil lamps lighted in the interlocking and automatic signals in its yards at that point, on account of the variable draughts sweeping across the bay, decided as an experiment to light twelve of these lamps from its electric light circuit, wiring the lamps in multiple.

So satisfactory were the results, that the number of signals so lighted have been increased gradually until 134 lamps in the interlocking and automatic signals, switchstands, switch lights and signal towers there are now lighted by electricity. Thirty-one of these lamps are in switches and signals that have underground wire connections, sixteen of them light up four signal towers, while the balance are in signals located on posts and connected by overhead wires, all being supplied by the arc light dynamo above referred to.

The signal lamps are 38 volt, and are wired from ten to fifteen in multiple, according to the number of signals within convenient distance to form a group, so reducing the E. M. F., that the lamps use only from 20 to 28 volts pressure, thus lengthening their life and yet giving sufficient amount of light to illuminate the bulls-eye lens of the lantern.

In wiring up the lamps, for the purpose of preventing trouble in case they should break or are burned out, a simple switch is used with paper between the contact points, so that in case a wire leading to a number of lamps is broken, an arc will form at the switch, burn the paper, and thus close the circuit.

In putting up the lamps for the signals, the lamp with its socket is screwed on to a rubber nipple placed in the centre of a wooden base, made the same size as the oil lamp bottom which it displaces, wires passing down through the rubber nipple and in grooves cut in the under side of the base, connect the lamp with binding posts on the corner of the base, which makes a complete and portable device for placing it in almost any style of lantern.

For the signals on posts a tin box or case was designed 7″ x 6″ x 3″ with lens on one or both sides and with wooden bottom made to hinge or screw at one end and fastened by a thumb screw at the other end, secured to the post by a pocket constructed on the narrow side of the case and an iron bracket on the post in the usual manner.

This box is made from one sheet of tin and is soldered tightly together with no openings except a bottom which is closed by the wooden lamp base. If well painted, white inside and green outside, this lamp case will last indefinitely. Where the lamps are most exposed to the assaults of the hoodlums with their little guns and stones, a wire netting of one-fourth inch mesh is fitted over the lens in the form of a pocket open at the top so the glass can be cleaned.

After being placed in position and wires connected, no further care or attention is required beyond occasionally cleaning off the outside of the lens.

The lamp complete, including case, base, lens, socket and lamp, costs about $2 each, as compared with about $5 each for the oil lamp complete, which lasted on an average of only two years. The lamps first installed over three years ago are still in use and have required no other care or attention than renewing the underground wire to two of them.

I am informed by Mr. Slater, the Master of Signals for the Southern Pacific Company, to whom I am indebted for many of these details, that the actual expense for the installation and maintenance of these lights beyond the interest on first cost for wire, lamps and fixtures, etc., is very small, the additional amount of power required for the signal lamps being only about five horse power, though in the system of accounting in use on the Southern Pacific Railway, $90 per month is the proportion charged to the signal lights, out of the total expense for maintenance of the whole system. Of the arc and incandescent lights in use at that point, thirty arcs being required for depot passenger yard and road crossings, with 56 sixteen c. p. multiple series incandescents for depot rooms and offices, and one 65 and one 50 c. p. series incandescent lamp for outside buildings. The total expense including the cost for four attendants, fuel, oil waste, and supplies, repairs, &c.

The division of the expense seems hardly fair, as in the installation of the signal lamps nothing was added to the expense for attendance or repairs to dynamo, engine or boiler, and very little to general supplies. All of these had to be maintained on account of the arc and incandescent lights already in use.

So well satisfied have the Southern Pacific Company become with the results from their electric light plant at Oakland that they have in consideration a larger one there to light the railroad shops, coal yards, ship and lumber yards, freight yards and ferry slips—and are operating electric plants at various other points on their line.

The above mentioned plant seems to be the only one thus far installed on so large a scale, and the results obtained evidence a large economy as against the use of the oil lamp for this purpose, where a railroad company owns and operates its own electric light plant of sufficient capacity to supply the signal lamps. As an illustration, the Central Railroad of New Jersey have 45 interlocking signal lamps at their Jersey City station, which consume five gallons of No. 7 oil daily, at ten cents per gallon, or $15.50 per month, with the two lamp men at $40 and $45 per month; the total expense for the 45 lamps is $100.50 per month, as against $90 for the 134 lamps of the Southern Pacific at Oakland, without considering the cost of breakage, the trouble from lamps blowing or bursting, which is likely to occur at Jersey City.

LIGHTING PASSENGER TRAINS.

In regard to the electric lighting of trains, this subject was so fully treated by Mr. Selden in his admirable paper read at the last meeting of the Association that there is little left for me to add; however, some facts have come to my knowledge that may be of interest in this connection.

In the United States at least the system of lighting from storage batteries, charged at each end of the run, does not appear to increase in popularity. The Boston and Albany railroad, after two and a half years' trial, recently abandoned electricity on the two trains that were so lighted between New York and Boston, and substituted the Pintsch gas system. It is stated that the principal cause of this action was the cutting down of the overhead wires in New York, preventing them from charging the storage batteries at that end of the line, as the cars were not equipped with oil lamps, which could be used during that time, but it is also claimed that considerable trouble was experienced from the lamps frequently breaking, and that the expense of maintenance was too great.

The Pennsylvania Company, however, still continues to light their parlor cars from the storage batteries, using a low voltage lamp.

The Intercolonial Railway of Canada have adopted the accumulator system alone on trains between Halifax and Quebec, and now have more than forty cars fitted up with electric lamps, which are of 16 c. p., and vary from eleven to twenty-two to a car. The accumulators are charged at four different points on the line, running about 500 miles with the one charge, and the results thus far obtained are very satisfactory; but to provide for emergencies oil lamps have been retained in each car.

The combination of dynamo and storage battery first adopted by the Pullman Company is gradually being extended in this country, and is giving great satisfaction in the East and West, but, it appears, at a large expense for maintenance. The Chesapeake and Ohio vestibule train, "Fast Flying Virginian," running between New York and Cincinnati with six cars, is supplied with 118 lamps divided up as follows: Two Pullman, 30 lamps each; dining car, 26; day coach, 16; combination car, 13; and the baggage car, 3. Up to May 1st, 1890, the average cost per lamp for maintenance and renewals was $1.10 per month. Yet where the exhaust steam is utilized for heating the train the cost can be materially decreased.

With this object in view the Chicago, Milwaukee and St. Paul Railway have recently added to their equipment two independent light and heat tenders, which carry their own boilers for steam

heating and for running a Westinghouse automatic engine, attached to a No. 4 Edison compound wound dynamo, supplying the current direct for lighting all the cars in the train, thus doing away with the dynamo on the baggage car and the storage battery combination.

The results have been very favorable, and during more than six months of constant service there has not been a single failure. This company have four trains, embracing about 45 cars, lighted by electricity, and expect to adopt this system of illumination on all of their through trains. A full description of the tender, with drawings and other details of the electrical arrangements, will be found in the *Railroad Gazette* of June 13th, 1890. It is stated that the expense of building and equipping these tenders is not much greater than the cost of the storage battery, dynamo combination, with the expensive wiring required in that system.

It is confidently believed that the cost of lighting trains by electricity in the United States can be greatly reduced by adopting the method so largely used abroad of getting power from the axle.

Mr. Houghton, the telegraph superintendent of the London, Brighton and South Coast Railway, one of the patentees of the system, advises me that there are sixteen trains running on that road which are so lighted, thirteen of them local trains and three express. The speed of the express trains reaches 70 miles an hour, while the locals run from 20 to 60 miles per hour. The express trains are wired for an average of 70 lamps and the others 40; the c. p. of these lamps varies from 8 to 16, according to the speed of the train.

The dynamo furnishing current for these lamps is placed in the baggage car, and has a pulley at each end connected by belts direct with the axles of the car. No intermediate shafting being used, the slack is taken up by loose pulleys that can be pressed upon the belts. The dynamos on these trains have a maximum capacity of 5,000 watts, varying with the speed of the train, which, at 10 miles per hour, gives about 48 volts and 35 amperes, and at 60 miles, 65 volts and 75 amperes. The E. M. F. and current of the dynamo gradually increase with the speed. The brushes are mounted in pairs on a rocking frame so arranged that either set of brushes can be brought in contact with the commutator as required by the direction of the train. In the same car with the dynamo, 22 accumulators, weighing about 4,000 pounds, are placed in parallel with the dynamo for use whenever the train stops. Connected by a belt from the dynamo is a centrifugal governor which joins up the circuit at any desired speed, causing the dynamo to charge the accumulators. When the lamps are not lighted, the governor introduces resistance into the dynamo field reducing the out-put to about 40 amperes, in order not to damage the accumulator plates. When, however, it is necessary to light the lamps, the ynamo generates the full current, of which about 35 amperes pass into the lamps, the balance being stored in the accumulators.

In each lamp circuit a regulator is placed in order to keep the light in the lamps at the same power, regardless of the speed of the train, and to shunt any surplus current into the accumulators, so that 42 volt lamps may be used with a dynamo of any E. M. F., above that voltage without any variation in the light of the lamps.

The connections between the cars are made by coupling two cables together, and when the dynamo runs below a certain speed a cut-out breaks the circuit of the armature, preventing the cells from discharging themselves through it and burning it out. Should the dynamo not furnish enough current for the lamps, the accumulators supply the balance, and in doing so strengthen the field magnets and thereby cause an increase of current in the dynamos. One arrangement of the circuits of these trains, has the field magnets of the dynamo wound with two wires in opposite directions, one of which is in shunt to the armature, as if the dynamo was an ordinary shunt machine; the other is wound in the reverse direction, as if the dynamo were a compound machine, and the accumulators are in series with that wire. The lamps are also in shunt with the armature.

The trains on which this system is used, consist mostly of ten cars, which run solid, that is, are not broken up, and average forty 12 c. p. lamps to a train. By using accumulators in each car however, no difficulty would be found in splitting up the train at various points.

The figures given by Mr. Houghton are as follows:

Total weight of the plant on each train, -	3 tons.
Cost of plant on each train, - - - - -	£400 sterling.
Cost of maintenance per annum, - -	£65 "

The only attention given the trains is at each terminus, where one man inspects the apparatus, oils the pulley bearings, etc., before the train pulls out. One of these trains has been running since December 19th, 1883, without a single failure being reported. During the first eleven months of its use it made 2,352 trips and ran 27,322 miles.

The Midland Railroad of England is running three trains lighted by electricity, and has recently fitted up two others. Two of these are short trains always run solid, and the others main line trains made up at various points. The dynamo is placed in the baggage car and is also driven from the car with about the same electrical arrangements as are used on the London and Brighton road. The short trains have 85 lamps run from one set of storage batteries in the baggage car. On one train the batteries are in series, but on the others in parallel. This seems to be the most satisfactory. 8 c. p. lamps are used on this road, two to each compartment, which can be turned down, and this feature is found to be very convenient to through passengers.

This system of illuminating passenger trains is becoming very popular in England, and it is believed that all such trains on the important roads of the Kingdom will shortly be equipped in this way. The expense as shown by seven years' experience on the London and Brighton road is certainly not greater than where common oil is used, and seems to corroborate the report made by MM. Sartiaux and Weissenbruch, to the International Railroad Congress at Paris, a year or two ago, in which it was stated that for lights of the same candle power, gas supplied by the Pintsch system would cost about 11.3 centimes, and colza oil about 16.9 centimes per lamp hour as against 5.6 centimes for the electric light.

Compared with the practice on American roads, the economy of this method of generating the current, is remarkable. It has been stated, however, by various authorities, that it is impossible to secure even fair results in train lighting in this country where the power is supplied by the car axle, owing to the numerous curves on American roads, around which the wheels will often slide without turning the axle a single revolution, thus seriously damaging belts and armature, and cause constant changes in speed; while English roads are almost always tangents, and a high and constant rate of speed is maintained. The experiments made here some years ago seem to corroborate these statements.

In 1886, or 1887, Mr. Barrett, of Springfield, Mass., fitted up a train on the Connecticut River railroad, to be lighted with electric lamps run from a dynamo, obtaining its power from the car axle. A countershaft was used and a peculiar arrangement of a friction clamp transmitted the power to a pulley on the shaft. This clamp was governed by centrifugal weights balanced by stiff springs. When the dynamo ran at its normal speed, these springs just balanced the friction of the clamp, and there was no slip; any increase of speed then caused the friction to diminish and the pulley slipped upon the shaft until the equilibrium was restored; 24 accumulators were connected with the circuit as a regulator, keeping the lamps lighted when the train stopped, and a centrifugal governor broke the accumulator circuit when the train slackened its speed. The brushes were attached to a rocking arm, or lever, which was tilted by magnets in either direction in accordance with the forward or backward movement of the train.

Owing to the arrangement of the car trucks, it was found very difficult to obtain the proper speed of the dynamo, and after successive trials with belts, ropes and chains, it was finally abandoned. Since that time there have been no further experiments of this character in the United States, but it is stated that such improvements are now being made in the driving gear as will obviate the difficulties heretofore encountered, and that further trials in this direction may be looked for within the next six months.

The electric lighting of trains has been hitherto considered very much as a luxury, but its superiority has been demonstrated in so many ways that it is now being regarded almost as a necessity; yet before it can be generally adopted it must be practicable to light the cars on a large scale, and to maintain the plant on each train in good order without expert assistance; it must also be so simple, and at the same time so durable, that mechanics of ordinary ability can be utilized to make the few repairs it will require; its cost, therefore, must be reasonable as compared with other methods of lighting, and the character of trains on which it is to be used.

From the facts above mentioned, it will be conceded that all of these requirements are filled by the English system of taking power from the car axle; it is, therefore, confidently expected that the well-known ingenuity of our American engineers and inventors will be found sufficient to overcome the obstacles which now prevent us from utilizing in the same way the motion of the trains on our roads.

The successful illumination of the Hoosac tunnel in Massachusetts, by 1,250 incandescent lamps placed 40 feet apart on each of the two tracks, affords a remarkable illustration of the flexibility and superiority of the electric light over other illuminations, and the advantages of the arc and incandescent light for the illumination of our depots, waiting rooms, train sheds and offices are so apparent, and well understood, and their use so extensive, that it is unnecessary to make more than a passing notice of this branch of the subject.

In thus considering the various directions in which the electric current has been adapted for illuminating purposes in the railroad service, one is struck by the extraordinary progress that has been made in the art during a few years, and the enormous possibilities that the future opens up for the utilization of this most wonderful of nature's forces. So much has already been accomplished, and so numerous are the workers in the new field, that before another decade of years has rolled around, steam will have been supplanted by electricity, as the motive power of our railroads, and the locomotive of the future will indeed be the the fiery steed called lightning harnessed and subject to the control of man.

THERMO-CHEMISTRY IN RELATION TO ELECTROMOTIVE FORCE.[1]

BY PROF. J. E. SIEBEL.

The quantitative relations between the chemical changes taking place in a galvanic battery and the quantity of electric power generated by such battery are well understood. The amount of heat generated in the whole circuit is equivalent to the total electric power or volt amperes (electromotive force times current strength), generated by the battery, and also equivalent to the amount of heat which would be produced by the chemical changes going on in a battery had the same not been converted into electric energy. Attempts have also been made to establish relations between the electromotive force and the chemical changes going on in a battery, and, according to Sir Wm. Thomson, the amount of heat corresponding to the chemical changes going on in a battery while one molecule of zinc is dissolved is proportional to the electromotive force of such battery. This, indeed, happens to come out correct in a case of some constant batteries having a depolarizer, but it can readily be seen that it is not generally applicable.

Take, for instance, the case of several elements, each made up of zinc as the electro-positive metal, acidulated water and another more electro-negative metal, say iron, copper, silver, etc. In the case of each of the different elements so formed the electromotive force is a widely different quantity, while the heat equivalent to the chemical changes in the battery, while one molecule of zinc is being dissolved, is the same in all cases, since no chemical changes take place at the negative electrodes.

Considerations of this kind and the conviction (based upon the result of certain deliberations, the drift of which it is not desirable to enlarge upon at present), that definite relations of some kind must exist between the chemical changes in, and the electromotive force of, a battery, have led me to the elaboration of a formula, which I think covers the subject quite satisfactorily. At present I will only consider its application to batteries consisting of two metals and dilute sulphuric acid. The electromotive force of such element is, according to the inferences drawn by me, nearly proportional to the difference of the heat which a molecule of each one of the two metals could evolve by being acted on by dilute sulphuric acid independent of the battery, under favorable conditions.

In order to establish the correctness of this assertion I submit the following table which also will more readily show the import of the rule referred to. The first column in this table gives the names of the various metals, the second column, their electromotive force in juxtaposition to dilute sulphuric acid, expressed in volts. In these figures the electromotive force of zinc may be considered as a number somewhat arbitrarily chosen, yet with reference to it the other figures represent electromotive force as established by Hockin and Taylor. (See *Journ. Tel., Eng. & Elec.*, 1879.) The third column shows the relative amount of heat in calories generated by one molecule of the different metals in being dissolved by dilute sulphuric acid. It is readily seen that the heat evolved increases with the electromotive force evolved in volts, multiplied by 1,000 for each calorie produced by the combination per molecule of the respective metal with sulphuric acid and the elements of water.

	E. M. F. Volts.	Calories.	Ratio.
Potassium	3.560	196,000	0.0180
Sodium	3.460	187,000	0.0185
Zinc	1.580	106,000	0.0140
Cadmium	1.220	89,500	0.0137
Tin	1.050	not determined.	
Lead	1.060	73,800	0.0143
Iron	1.130	87,200	0.0120
Copper	0.580	56,000	0.0104
Silver	0.300	20,400	0.0147
Gold	0.280	not determined.	
Mercury	0.260	" "	
Platinum	0.150	" "	
Carbon	—0.276	—18,500	0.0148

Although the figures in the fourth column are by no means exactly alike, as they should be in accordance with the theory propounded, yet they show plainly enough that a direct quantitative relation exists between the electromotive force and the heat of combination; moreover, it should be considered that it would have been a very easy matter to make them correspond exactly to my theory by substituting the value of some electromotive forces by such as have been obtained by some other observers. Furthermore, it is also to be presumed that other atomic properties do in some measure affect the above relation; indeed, the fluctuations in column four in some measure appear to follow the fluctuations in the atomic volume of the different metals.

So far as the limited amount of observations in regard to electromotive forces and thermo-chemical phenomena have enabled me to go, I find the above relations maintained in batteries composed of other materials than the ones selected above; moreover, the applicability of the law of Sir Wm. Thomson above quoted in regard to certain batteries would seem to be a special case falling under the above generalization.

As stated, the values of the electromotive forces in the second column of the above table are based on the determination made by Hockin and Taylor. They were, however, reduced to zinc not amalgamated. In the case of sodium and potassium the electromotive force had to be corrected also, as a solution of sulphate of zinc was used, instead of dilute sulphuric acid, as in their case. Carbon not being mentioned by them, this item was supplied from the observations of Branly (*Ann. Sc. de l'Ecole Normale*, 2, p. 228, 1873). The thermo-chemical data in the third column was taken from a table in A. Naumann's "Thermochemie," 1882, page 481. The item relating to carbon, representing the heat evolved by carbon in combining with hydrogen, was taken from the same source, page 413, and it is placed in the negative, representing as it does, not an actual change, but a demonstration of an affinity or tendency acting in opposite direction to that of zinc and other more electro-positive metals, the tendency of which is to form oxygen compounds under the circumstances in consideration. It will also be noticed that the relative electromotive forces will not be changed by adding or subtracting the same number in case of each of the figures in the second column, and that by changing these figures in this manner the relations referred to may possibly be brought out more correctly.

Connected with the above subject, at least as regards the theoretical considerations involved in both, is a method of producing refrigeration by means of electricity, planned some time ago. It contemplates the creation of cold in such a manner that the heat abstracted from the medium to be refrigerated is made a source of power, instead of being wasted, as is done in the refrigerating machines of the present. This it is proposed to bring about by the decomposition of water under high pressure by an electric current produced by a dynamo or otherwise. The gases so produced, namely, hydrogen and oxygen, either singly or mixed, are used to propel engines by reason of the energy they possess being under high pressure.

After having done work in this manner and having had their temperature reduced correspondingly, the gases can be used for refrigerating purposes by being carried through the rooms to be cooled. After this the gases, by virtue of their chemical affinity toward each other, still possess sufficient energy to be utilized in the form of electricity or mechanical force for the decomposition of the water. In this manner the power of the engine in which the compressed gases expand and the refrigeration would be clearly gained. This, of course, is speaking theoretically; practically there are, of course, losses of power the extent of which I have not yet undertaken to determine. Theoretically speaking, however, I have been unable to find any great objection to the system proposed, but am very much pleased to have had an opportunity to lay the subject before a body of men, some of whom, doubtless, would be able to point out such difficulties if they really exist.

To caution those who are apt to see an attempt at perpetual motion in the above method, I will distinctly state that the above device is nothing of the kind. It is a system calculated to effect the conversion of low differences of heat potential into mechanical power; but it is not an attempt to create power from nothing, which is the essential of perpetual motion as it is popularly understood. For, although theoretically speaking, such an arrangement would keep in motion forever under ordinary circumstances, after being once set in motion on the above plan, yet it would stop at once if the difference between the temperature of the expanded gases and that of the rooms or tanks to be refrigerated should fall below a certain limit, as might indeed happen in cold weather or in a cold climate.

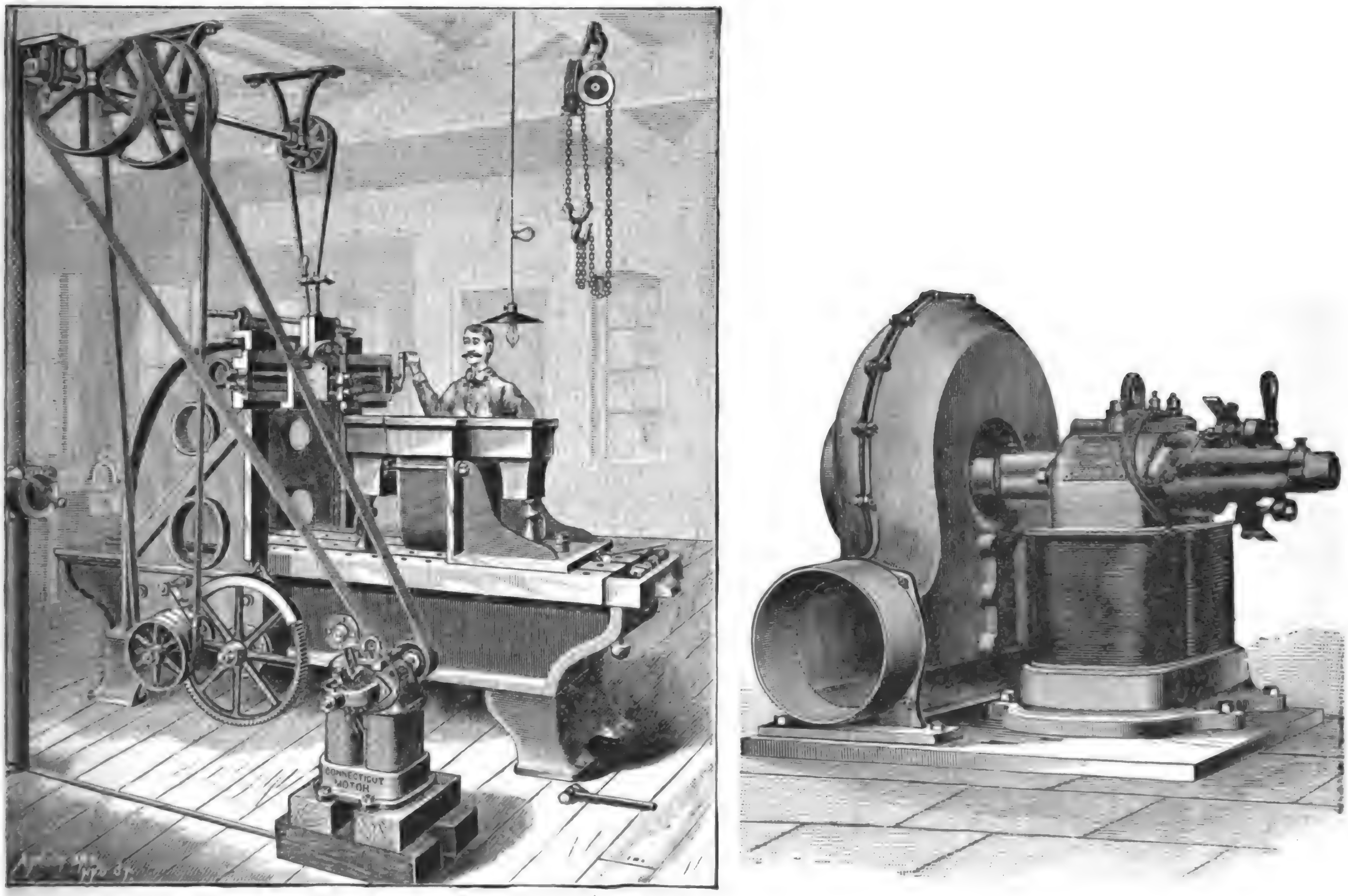
1. Read before the Chicago Electric Club at their second annual meeting, June 27, 1890.

ATMOSPHERIC ELECTRICITY IN THE TROPICS.

In order to investigate the relations of atmospheric electricity to the moisture of the air within certain limits, Herr F. Exner has made observations of the fall of atmospheric potential in countries with high relative moisture, particularly in the Indian Ocean between Aden and Bombay, in Bombay itself, and in Ceylon, both on the coast and in the interior. The measurements were made with transportable apparatus invented by Herr Exner. All the values of the fall of potential were positive. Near the coast the finely-divided spray arising from the breaking of the waves exerted an increased action on the fall of potential. On the other hand, measurements made in Cairo and the vicinity showed that there the dust of the air, exerted a lessening influence on the fall of potential, which, with a strong wind, was so marked that the sign of the fall of potential became negative.

SOME WORK OF THE CONNECTICUT MOTOR.

It may safely be claimed that for nearly all purposes where power is required, the electric motor possesses decided advantages over all other power generators; while in many cases its advantages place it far in advance. Thus there are situations where it is practically impossible to generate power, as in stamp-mills on mountain ledges, drills on quarry faces. Again there are situations where it is inconvenient to generate power, as on draw-bridges, travelling cranes, etc. There are still other situations in which it is frequently unprofitable to generate power, such as small shops requiring a few horse power to drive the machinery, and where a steam engine would entail a disproportionately heavy outlay and continual expense for maintenance. In all these situations the electric motor finds a large field for application and is now being employed.



Figs. 1 and 2.—Connecticut Motor Driving Machine Tools and Blower.

As an example of this we illustrate in the accompanying engraving, Fig. 1, a shop the machinery of which is driven entirely by a motor built by the Connecticut Motor Co., of Plantsville, Conn. Besides the shop shafting, there are eight tools, consisting of drill presses, planers, lathes, blower, etc., consuming all the way from one-quarter up to three and one-quarter horse power.

The engraving, Fig. 2, shows a motor built by the same company and directly connected to a blower.

AMERICAN NAMES FOR ELECTRICAL UNITS.

At the regular monthly meeting of the American Institute of Electrical Engineers, held June 17th, 1890, the following resolution recommended by the council was introduced by Mr. Francis B. Crocker, with the request that it be taken up for action at the next meeting of the Institute in September:

Whereas, it has been the custom in the nomenclature of electrical units to perpetuate the names of men who have contributed most to electrical science; and

Whereas, in the names thus far adopted the eminent services of Americans have not been recognized; therefore

Resolved, that in the opinion of the American Institute of Electrical Engineers, a just distribution of the honors thus bestowed necessitates a recognition of the splendid contributions to electrical science of one or both of America's great electricians, Benjamin Franklin and Joseph Henry; and

Resolved, that this Institute will gladly co-operate with other bodies in this country and abroad to secure the general adoption of these names for electrical units; and

Resolved, that the name of Henry should be given to the practical unit of self-induction, since he was the discoverer and greatest investigator of this phenomenon, and because this unit at the present time is called a quadrant, which is merely a numerical value and not a suitable name.

Resolved, that this Institute recommend to electrical societies and electrical engineers the general use of the name of Henry for the unit of self-induction as being the quickest and surest way to secure its final adoption.

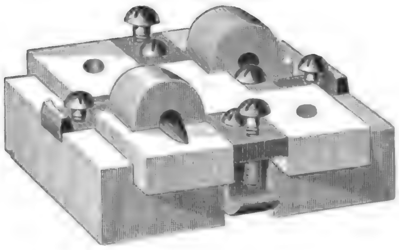
It is unfortunate that the name of Henry for the unit of induction was not adopted at the Paris Electrical Congress of 1889. If the attention of the Congress had been forcibly called to the fact that Henry discovered self-induction and that his work on both self and mutual induction was of the greatest importance, his name would probably have been adopted then. Henry's discovery of self-induction, which is, of course, the fact that gives the strongest claim, was made in 1832 and published the same year in Silliman's Journal. In this paper he describes experiments showing that the spark obtained by breaking a circuit composed of a battery and a long wire is greater than with a short wire, and that the spark is further increased by coiling the wire. He then clearly states that the phenomenon is due to the *action of the current on itself*, all of which is perfectly correct and would be a good statement of the facts even at the present time.

THE EMPIRE CITY SUBWAY COMPANY.

The Empire City Subway Company, Limited, has filed a certificate of incorporation at Albany. The company is formed for general subway work in New York City and elsewhere in the State. The headquarters of the business is in New York, and the capital of the company is $500,000. The incorporators are William T. Bouchelle, John C. Reilly, Union N. Bethell, Hiram F. Stevens and David B. Parker.

THE "CUTTER" BRANCH CUT-OUT.

Among the many specialties which that enterprising new firm, the Great Western Electric Supply Co., is putting on the market, is a branch cut-out with a number of novel features. The cut shows the Cutter branch cut-out complete. It consists of a peculiarly shaped porcelain base and four brass connecting pieces. The brass pieces are set into recesses in the porcelain, two of them clamping a reduced section of the porcelain and all four being firmly held by single screws from below. These screws go in far



The "Cutter" Branch Cut Out.

enough to admit a thick insulating coating between them and the back, so that the block may be safely set against a damp ceiling. The wires are readily fastened without removing any screws. Neither the main nor the branch wires need be cut, but are merely bared opposite the fastenings, and owing to the shape of the porcelain block the main and branch wires can never touch each other. As

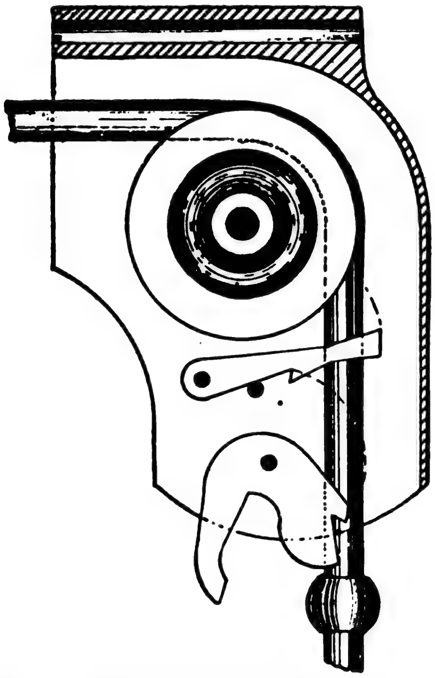


Fig. 1.—Arc Lamp Suspension Pulley.

common screws are used throughout, any lost ones can be readily replaced.

These features will commend themselves, but perhaps a still more novel one is that of a bridge covering the central portion of each fuse. The fuse is easily put in place, and when it burns out the bridge restrains the sputtering and catches the burnt metal. Thus the bridges give the effect of a cover, although fireproof, and are neater and cheaper. The whole is strongly made, nearly twice the size of the cut, and suited for 20 amperes or less.

A NEW ARC LAMP SUSPENSION PULLEY.

Among the numerous new and useful electrical devices which are being brought out by the Great Western Electric Supply Company, of Chicago, is a pulley for suspending arc lamps, which possesses some features of considerable merit. By its use the weight of the lamp is supported by the mechanism in the pulley case, and the hoisting rope is relieved of all strain. Those who have suffered from broken lamps caused by the parting of the hoisting rope will appreciate the advantages of the new device.

The accompanying illustrations show clearly the manner of operation. Fig. 1 shows the position of the parts when the lamp has been raised to nearly its proper elevation.

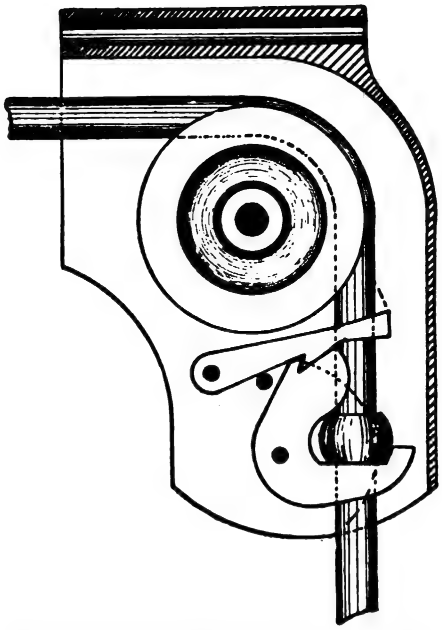


Fig. 2.—Arc Lamp Suspension Pulley.

By slightly raising the lamp, the knob upon the rope engages the nearest bifurcated end of the swinging pawl, which revolves upon its axis into the position shown in Fig. 2, the other end of the pawl swinging under the knob upon the rope. The lower, or supporting, pawl is securely held in position by the upper pawl as shown in Fig. 2. The

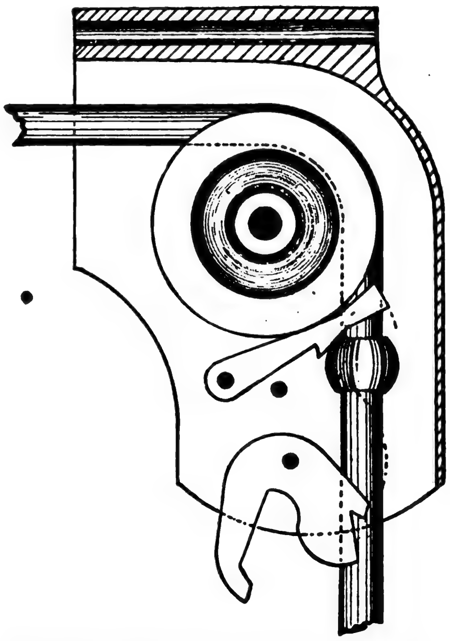


Fig. 3.—Arc Lamp Suspension Pulley.

lamp is thus supported by the knob on the rope resting upon the lower pawl.

To release the mechanism, the lamp is raised until the knob on the rope engages the end of the upper pawl, which is by this means raised enough to release the lower pawl; the latter then swings downward and permits the lamp to

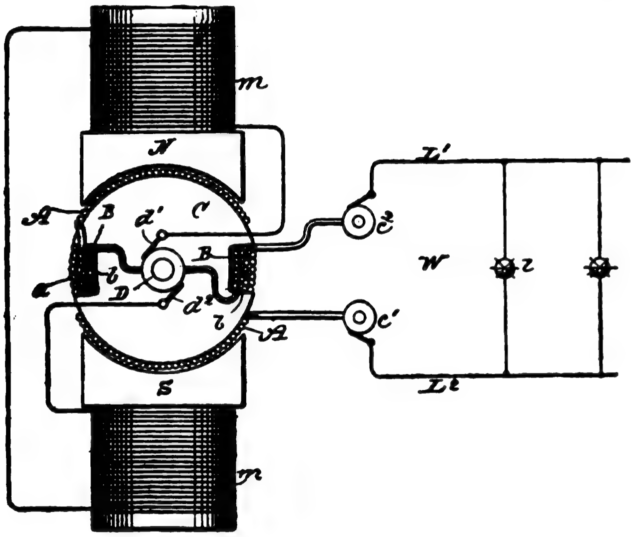
be lowered. The whole mechanism is controlled by the hoisting rope, and no auxillary cord is needed.

The mechanism is very simple and entirely automatic in its action. It is the invention of Jas. A. Lounsbury, of the National Engineering Bureau, of Chicago.

STANLEY'S SELF-REGULATING ALTERNATING MACHINE.

With the object of maintaining constant potential in alternating machines under all variations in load, Mr. Wm. Stanley, Jr., has recently designed a type of machine in which the excitation of the field magnet is automatically varied proportionately to the amount of load. He accomplishes this by the construction illustrated diagrammatically in the accompanying engraving, in which for the sake of clearness only two armature coils are shown, one supplying current to the external circuit and the other energizing the fields.

As will be seen, C is the armature-core, upon which are wound independent armature-coils, A B, at right angles to one another. The armature-coil, B, is wound in a recess, b, so that it lies within the exterior circumference of the core, and its terminals are connected with the field-magnet



Stanley's Self-Regulating Alternating Dynamo.

coils, m m, by means of a commutator, D, and brushes, d' d^2. The coil, A, is connected with the mains, L' L^2, by means of collector-rings, c' c^2. Applied to the coil, B, is a supplemental coil, a, consisting of a comparatively few turns of wire and connected in series with the coil, A.

It is evident that current from the coil, A, will flow through the supplemental coil, a, at the moment when the coil, B, is in its position of minimum electromotive force, and the flow of current through the coil, a, will develop lines of force in a direction operating to strengthen the polarity of the armature-core and increase the number of the lines of force threading the coil, B. On an increase in the current in the external circuit there will be a decrease in the difference of potential between the terminals of the coil, A, supplying current to the circuit, and in order to maintain the difference of potential constant an increase in the excitation of the field-magnets is necessary. The fall in potential is, however, accompanied by an increased flow of current in the external circuit, and consequently through the supplemental coil, a, and the number of lines of force of the magnetic field of the machine threading the coil, B, is augmented by the additional lines of force developed by the increased flow of current through the coil, a; hence there will be an increase in the potential developed in the coil, B, with a corresponding increase in the excitation of the field-magnets, and the difference of potential between the terminals of the work-circuit will be maintained constant.

Conversely, the tendency to a rise in the difference of potential between the terminals of the work-circuit consequent upon a decrease in load will be checked, since the number of lines of force threading the coil, B, will decrease with the decrease in the quantity of current flowing through the coil, a.

It is evident that the position of the coil, a, will be reversed with each reversal in the direction of the current flowing through it, and thus the lines of force developed by the current in the coil, a, will maintain a constant direction, as related to the direction of the lines of force of the magnetic field of the machine, and will always operate to assist the magnetization of the armature-core.

THE ELECTRICIAN OF THE CHICAGO WORLD'S FAIR.

We have received a copy of the following petition:—

We, the undersigned, representing electrical interests and industries, request the selection of Mr. J. P. Barrett, Electrician of the City of Chicago, by the Board of Directors of the World's Columbian Exposition, to have practical charge and control of the Electrical Department of the Columbian Exposition:

Frank A. Wunder, Western Agent Schuyler Electric Company; Frank J. Baker, Western Agent United Electric Traction Co.; F. S. Terry, Manager the Electrical Supply Co., President Chicago Arc Light and Power Co.; B. E. Sunny, Western Manager Thomson-Houston Electric Co.; F. S. Gorton, Manager the Chicago Edison Co.; W. P. Adams, General Manager Western Power Construction Co.; Herbert Wadsworth, Western Manager Excelsior Electric Co.; Jas. A. Lounsbury, National Engineering Bureau; H. F. Winston, President Illinois Electrical Material Co.; W. S. Salisbury, Electrician American Electric Motor Co.; E. M. Barton, President Western Electric Co.; C. A. Brown, Vice-President Electric Illuminating Co.; C. H. Wilson, Superintendent Chicago Telephone Co., President Chicago Telephone Co.; H. B. Stone, President Central Union Telegraph Co.; E. B. Chandler, General Western Agent Gamewell Fire Alarm Co.; L. B. Firman, General Manager the Police Telephone and Signal Co.; Francis W. Parker; George C. Bailey, Manager John A. Roebling's Sons Co.; F. G. Beach, President Chicago Electric Club; Foree Bain, Electrical Engineer, Chicago; John W. Calkins & Son, Chicago Office Rockford Electric Manufacturing Co.; E. E. Keller, Manager Chicago Office the North American Cons. Co.; E. L. Powers, Manager *Electrical Industries*; H. W. Hall, Manager the Hall Signal Co.; Edward Stockwell, Agent Ball Electric Light Co.; McIntosh Battery and Optical Co., 141 and 143 Wabash avenue; Electrical Merchandise Co., A. H. England, Secretary, 11 Adams street; J. L. Barclay, General District Agent Westinghouse Electric Co., Railway Department; B. F Stewart, President Emery Electric Mining Machine Co.; C. B. Osgood, Contracting Agent Westinghouse Electric Co., Railway Department; C. W. Barclay, 151 Van Buren street; Chas. T. Page, Secretary and Treasurer Englewood Electric Light Co.; Geo. H. Bliss; R. C. Clowry, Vice President and General Superintendent Western Union Telegraph Co.; F. H. Tubbs, Superintendent Western Union Telegraph Co.; W. J. Lloyd, Assistant Superintendent Western Union Telegraph Co.; Elbert C. Ferguson, Attorney, 94 La Salle street.

ELECTRIC WELDING AND ICE MACHINES.

The ice famine is proving a bonanza for the Thomson Electric Welding Co., says the *Boston Advertiser*. There is a great demand at present for pipe welding machines, with which to make the long coils of pipe for artificial ice machines, for brewery coils, for sugar refinery and general refrigerating purposes. The pipes originally come in lengths of from 18 to 20 feet. The coils are frequently 600 to 700 feet long. By old systems the pipe is welded together by a slow and laborious process, requiring fifteen minutes for each weld, two blacksmiths and a dozen helpers and a large space, each pipe being lifted from the forge to the anvil and a mandril inserted. There is often a serious loss of ammonia as a consequence of imperfect welding. By the electric process the welds can be made so homogeneous that there is no chance for ammonia to escape. The length of time required is two minutes for each weld, and all the help required is a man and a boy. The cost of the old process is fifteen cents each; by the new, two cents. As the coil is bent after each weld, the work can be done in a very small space. The managers of the Welding Company consider this, next to shell welding, the most important industry which has sprung up as a result of the welding invention.

A Magnet for Gold.—Mr. A. W. Chellis, has, it is stated, been exhibiting at Truckee, Cal., an "electric mineral ball," which has an attraction for gold.

THE STORAGE BATTERY IN TRACTION WORK [1]

BY J. K. PUMPELLY.

When I had the honor of addressing you a short time ago, I attempted to show how useful storage batteries could be made, and to what extent economy could be effected by them. The question was then asked, why it was that storage batteries had thus far failed to realize the predictions made concerning them. This question I propose to answer, basing my remarks upon actual tests that have been made in street car traction, the most difficult, probably, of all work they have been set to accomplish.

Why, with all this force at hand, and under control of man, has there been such failure in street car work? Let us study well the problem, and by the experience of practical, earnest men, determine whether we ought not to charge ourselves with much of the failure; we may find that the obstacles to success come from the outside, and not from the batteries themselves. We have given our young horse too much to do. Could we have understood the language of our straining, overworked street-car horse or the more patient mule, we would have known long ere this how varying is the traction work on a street car. To show this I need only cite Mr. A. Reckenzaun's very elaborate paper on electric traction.[2]

You will see by the practical notes of Mr. Reckenzaun, that the condition of the track and roadbed and the quickness, watchfulness and coolness of the switchman on the car platform, has much to do with the success of electrical traction, especially when a stored power is used. This last quality in the driver, or man who controls the out-put of current, who knows by experience what he needs and what is wasteful, can make the use of storage batteries economical, or otherwise. A car has lately been filled up with batteries at the order of the Middleborough Land Co., of Kentucky, which is completely controlled by the switchman. The batteries are connected in parallels of 25 cells each, aside from the regular series connections, and as 100 cells compose the outfit, the switch is divided into sections of four with resistance between each section to prevent flashing, when rapid changes are made under a strong current. Thus the switch acts much as does the steam throttle in the hands of the engineer.

To give the first impulses for a start, 25 cells of the battery are thrown into circuit with the motor, which is thus saved from heating or straining, and at the same time feeds the impulse of magnetization which starts the armature; the counter E. M. F. which begins to be created as the armature revolves, permits of a stronger current and the movement of the switch to the next segment, throwing in 50 cells and then 75. When the car is well in motion the counter E. M. F. allows of the entire battery of 100 cells being switched in series. Thus it can be seen that although a current of 50, 60 or 80 amperes is needed to start a loaded car, this current is divided up so that one group of batteries helps the other by dividing up the load, taking less out of each cell and also saving the motor from heating.

Still the question is asked, Why, if the success is such as represented on the above mentioned road, are not all doubts settled and the storage battery generally adopted? It is certainly the ideal method for street-car traction; each car being independent of any other, motion can be forward or backward. A car can even be run off the track, and if out of order run over the main road to the car house, if not too far away. There are two reasons for this hesitation. First, some of the batteries heretofore used are not durable enough, their mechanical building up or putting together of the plates fails to resist the jar of the railway and the sudden increased draught of current to which the battery is often subjected. In these batteries any touching of the two opposite pole plates destroys the efficiency of the entire set and nothing can be done to remedy the evil for the time, but to take out the one disabled cell and put in another. Now this tendency of the plates to get together is constant and comes very likely from the unequal expansion of the lead support which holds the active material and is a conductor for the current. There is also a tendency of the blocks of active material to flake off or to fall out under a jar, the pieces or flakes often catching between the two plates, which are never over ¼ of an inch apart, and thus short-circuiting the battery and rendering it useless. Fine crystals of lead sulphate slowly form between the plates, and in this way do the damage in the most mysterious manner, for these crystals can hardly be seen.

The second reason is to be found in the weight of the battery, and as constant efficiency depends very much on the weight of lead and lead oxide of which the battery is made to-day, it cannot be avoided unless the managers of the road look at it in the right way and arrange shorter trips and more frequent changes. For instance, suppose a six hours trip of 40 or 50 miles (like the example mentioned above), needs a battery of 150 ampere-hours capacity; to obtain this capacity we must have at least 80 batteries weighing 35, or, more likely, 40 pounds each; all this weight besides the car, motor and load must be supported and propelled by the forces excited in the battery itself. What would be the most practical and sensible way to improve this condition? Surely to shorten the trips, and as we learn by experiment that it needs a battery of 150 ampere hours capacity (and which capacity depends upon a certain weight of batteries), to run 50 miles at 8 miles an hour, then why not use a 100 ampere-hour battery, weighing say 25 lbs., and run 30 mile trips. The batteries, being lighter, could more quickly and easily be slid into and out of the car, more quickly charged, and cost less money per cell. If the trip occupied four hours to run the 30 miles, then four hours would be sufficient to charge the exhausted battery with 100 amperes, the dynamo delivering a current, in charging, of 35 amperes per hour, which would be a fair normal current for a properly constructed battery.

Most of the batteries of this size and weight will not bear a charging current of 35 amperes, and this has been one of the troubles that the experimental street railways have had to contend with. I am sure, however, that a battery is now on the market which will take such a current, will not get out of order, will not be injured by jar or heavy current discharge, in which the plates lie horizontal in the cell, and all opposing pole plates are separated from each other by intervening sheets of porous absorbing and non-conducting cellular fibre, inert and non-corroding in the electrolyte, and by reason of which the internal resistance is not increased, although it has been contended by many that this latter objection would exist.

I am also quite confident that another battery will soon appear in which faults before found in storage batteries will be overcome, not by lessening the weight of the battery, but by avoiding uncertainties caused by buckling, etc. These batteries are mentioned here merely to show that when all the arrangements are made on the road, their ability through proper construction to do the work constantly, can be depended upon. If, indeed, we have not this certainty of durability, all data, all estimates are useless and merely waste of time and money.

A word regarding the economy of traction by storage battery compared with that by means of the overhead wire. It takes an engine of at least 250 h. p. and a dynamo of the same power, constantly running, to propel seven cars over the above-mentioned route. To charge 560 batteries, that is, one set of 80 cells for each of the seven cars, would need an engine of 58 h. p., a dynamo of the same power of 1,340 volts, delivering a current of 35 amperes; and this dynamo would have to run four hours. If the trips were arranged for a change of batteries every four hours after the first set were charged, a 58 horse-power dynamo and engine would do the work, or, better, two 30 horse-power dynamos running only part of the time.

The dynamo for the overhead system must keep the E. M. F. constant, whether seven cars are running, or a less number. It must also supply such constant E. M. F. that the motor at the end of the wire, six miles away, shall receive the same electrical impulse as at the end near the source of power, and it is well-known what the drop in the line is per mile and the loss of power. We find that 10 per cent. yearly on the first cost of the batteries will make up for any deterioration in a well-made battery, and that amount will keep in order the overhead wires.

It might be of interest to mention here in closing the Patton motor system now being thoroughly tried at Pullman, in which great interest is taken by street railroad men, not only because it can be made quite independent of short stations, avoids the necessity of charging batteries and can use as trailers hundreds of street cars too lightly made or too old to support a set of heavy batteries.

The locomotive car is something like the grip car, although it carries in the centre a gas engine of 7½ h. p., with a tank sufficient to supply fuel for many hours and a dynamo of 7½ h. p.; while underneath are 60 storage cells and a motor of 15 h. p. In front there is still room to seat 20 or 30 persons.

By referring to the data on traction, just read, you will appreciate the principle and economy of this plan. We learn that an average run on the generally used lines of street railway uses 4½ h. p. of energy and only in starting, ascending grades or turning short corners is much more power needed. Hence in the Patton system a current sufficient to charge 60 cells with 15 amperes, under a pressure of 170 volts would keep the batteries charged, although part of the current, sufficient to generate 4½ h. p., was being constantly drawn out of the battery while running on a level.

Now, as the pressure is constant at about 2.4 volts for each cell, or about 170 volts, the current necessary to do the work is drawn from the battery; when the pull comes, such as ascending grades, going around curves, or starting, then the counter E. M. F. developed in the motor, which is wound to develop 20 h. p. under the pull, would lower the voltage to that of the sixty cells on discharge. The instant this takes place, the current flowing into the motor from the batteries is always sufficient to develop the full power needed, and this equilibrium is automatic. As the voltage of a battery on the first moment of discharge is always higher by .1 of a volt per cell there would be developed from the battery of 60 cells, at the moment it was called upon, a higher efficiency than could be estimated on a basis of average efficiency, and hence we

1. Abstract of paper read at the Second Annual Meeting of the Chicago Electric Club.

2. See The Electrical Engineer, June 18, 1890.

learn from varied trials that the battery thus constantly charged exerts tremendous and unestimated energy at the moment, very much as a man or a horse can exert unusual power under excitement or strain.

It is found that on a level track, two loaded cars can be drawn at the rate of 12 miles an hour, around curves and up 3% and 4% grades, and often when the longest runs have been made on a level, needing only 4½ h. p. and the cells have become so fully charged that the engine is shut off and many miles are run with the battery alone. In this case also the E. M. F. from the battery can always start the gas engine. Now if a 7½ h. p. engine and dynamo will do the work by the use of the most condensed and convenient form of fuel, seven cars would need only 52½ h. p. in engines.

It is claimed that this car, with one loaded car attached, can be run at a cost of 1¼ cents per hour. The size of the oil tank, which it would be convenient to carry, would be the only limit to the distance run. Of course, stations at proper distances apart could be made, to renew the tanks. In a short time every day work, the only real test to success, will show just how practical and economical this, like other systems, can be.

CORRESPONDENCE.

CHICAGO.

A New Conduit Railway System—A New Washburn & Moen Plant—Street Lighting—Electric Railway Work.

MR. C. K. HARDING, an inventor of Des Moines, Ia., is stated as having perfected an entirely new underground electric system for operating street cars without the use of the unsightly overhead wires. He abandons the slot idea, which has been heretofore unsuccessfully worked upon by numberless inventors, and used a tight conduit in which the main wire may be thoroughly insulated. A company has been formed with a capital stock of $600,000 to push the invention.

A rumor was recently circulated to the effect that the Washburn & Moen Manufacturing Company of Worcester, Mass., who produce an enormous amount of iron and copper wire every year at their large factories, a large portion of which output is used in electrical work, were negotiating for the purchase of a large tract of land in South Chicago for the erection of extensive works. It is now definitely understood that an arrangement has practically been completed for the purchase of fifty acres of land lying directly south of the property occupied by the Calumet Iron and Steel Company. The only step necessary to a consummation of the deal is the examination of the titles and the signing of the necessary papers.

An application for the extension of the electric lights on West Lake Street, as far as Western Avenue and around Union Park, on Randolph Street, has been favorably considered by Controller Onahan. There is plenty of room for increasing the number of arc lights now in use for street lighting, and we hope the day is not far distant when the brilliant and penetrating arc-lamp will supercede the sickly gas-lamps which now vainly struggle to illuminate Chicago's magnificent boulevards. It is time the pallid gas jets were laid away in innocuous desuetude to make place for their incomparable successor, electricity.

The Calumet Electric Railway Company has been stopped by the Street Department from proceeding with the laying of tracks on Ninetieth Street and Mackinaw Avenue, South Chicago, because the rails have not been submitted to the Commissioner of Public Works for his approval, as required by the ordinance. The representatives of the Company called upon Commissioner Purdy Wesday afternoon and informed him they could furnish a certain kind of rail, which the Commissioner said was satisfactory, and he therefore permitted them to go on with the work.

CHICAGO, July 4, 1890.

BOSTON.

Villard Deal—Heavy Traffic in Electric Roads—Governor Brackett Vetoes the Consolidation Bill.

MESSRS. COFFIN AND GRIFFIN of the Thomson-Houston Electric Company have returned from New York, and report has it that the Villard deal has not gone through. Mr. Villard has sailed for Europe and it is not expected that any further transactions will be entered upon until his return. The pooled stock can either remain, pending further negotiations, or be taken out at the option of the stockholders.

The electrical system of the West End Company has been taxed to the utmost this week, when it became necessary to transport about 10,000 people every evening to and from Oakland Garden, where the gigantic spectacular play of the Fall of Babylon is being enacted. With the exception of a few delays on the opening night, it is creditable to the management of the road that they have managed successfully to cope with the enormously increased traffic.

Governor Brackett has vetoed the bill authorizing the consolidation of gas and electric companies. His chief objections were the chance for unlimited expansion and the valuation of the new stock for taxation.

The legislative investigation as to the methods of the West End Company in procuring the passage of their bill is finished, and a unanimous report has been presented by the special committee and accepted, in which it finds that the charges of bribery are wholly unsustained, but admits that large lobbying expenses were incurred, not only in entertaining members, but in retaining such members as were deemed necessary.

As a consequence of the above report, the House of Representatives has passed the West End Bill for an elevated road to be engrossed on a vote of 97 to 72, and has also passed a bill to legalize the lobby, as suggested also by the special committee's report. The next step was to obtain Governor Brackett's signature to the West End Bill, and this was obtained at 11 o'clock on Tuesday night, and the West End Elevated bill has now become a law. Half an hour later Secretary of State Pierce announced the prorogation of the Legislature for the season.

BOSTON, July 5, 1890.

A NEW YORK GENERAL SUBWAY COMMISSION PROPOSED.

The last act of the June Grand Jury was to make the following presentment in Part I. General Sessions:—

From evidence presented to the Grand Jury we find that the contiguity of steam, gas, and water pipes, of sewers and electric subways in and under the roadbed of our principal streets, is an evil which demands immediate relief. The uptearing of the pavements caused by the laying of these pipes and their frequent repairs is an obstruction to travel and a needless expense to the city. The over-heating of the soil and the adjacent water pipes is destructive to pavements of asphalt, and makes Croton water unfit to drink. The saturation of the soil with poisonous gases and dirty fluids is damaging to health. The explosion of gases and the liability to explosion by steam are constant menances to life and limb.

These evils have increased from year to year, and will continue to increase unless some remedy is found.

As a present remedy we suggest that steam and gas companies be held to strict accountability for all damages occasioned by their neglect, that penalties be rigidly enforced against companies that delay repairs and obstruct travel, that no more permits be granted for the laying of additional steam and gas pipes in streets that are now overcrowded.

As a future remedy, we suggest the appointment by the proper authorities of a commission of strictly non-political experts who shall consider the feasibility of vesting the management of street paving and of all underground pipes and sewers, and of devising a new system by which the benefits of steam, gas, water, electricity, and sewage can be had more safely, and with less official obstructions.

REMARKABLE EFFECT OF ELECTRIC OSCILLATIONS.

A remarkable effect of electric oscillations has been recently pointed out by Prof. Minchin in *Nature*. Two metal plates attached to platinum wires are sealed in a closed glass vessel containing alcohol. One of these plates has been previously sensitised by some process not described; and it is found that, if light falls upon this its potential differs from that of the second plate by more than half a volt, and may be detected by an electrometer. A slight tap will, however, render the cell insensitive to light; a second tap will restore the sensitive condition, and so on, the two states occurring alternately, and being indicated by the movements of the needle to and from the zero position. The influence of an electric spark on such a cell is still more remarkable. If the cell is in the insensitive condition, the sensitive state can be at once restored by simply causing a spark to pass between the terminals of a Wimshurst machine or of a Hertz oscillator. The effect takes place even if the spark is caused at a distance of many feet from the cell. Prof. Minchin explains the effects by assuming that the molecular state of the surface is altered, and assumes that light energy can be taken up electrically for one condition but not for the other.

COMPLAINING LONDON TELEGRAPHERS.

The agitation among the telegraph operators for higher wages is assuming serious proportions, and is causing great delay in the service. It has even been rumored that the British Government will apply to the American telegraph companies for a large force of operators in case the dissatisfied men go on strike. The employés are indignant over this proposed action and will request their American craftsmen not to help the Government to grind them down to starvation wages. Several employés were discharged last week for participating in the indignation meetings. A wholesale strike is expected this week.

SOCIETY AND CLUB NOTES.

NATIONAL TELEPHONE EXCHANGE ASSOCIATION.

Gen. C. H. Barney, secretary, has issued the following notice:—

The next annual meeting of this Association will be held at the Russell House, Detroit, Michigan, commencing on Tuesday, September 9th, next. It is expected that the business of the Association will be concluded in two days, but the Secretary has received a hint that it will be advisable for the delegates to make their plans so as to remain in Detroit until Thursday evening at least.

The Russell House is conducted on the American plan. The rates are $3, $3.50, $4 and $4.50 per day, according to location, and accommodations desired. It is requested that members of the Association intending to be present at the meeting, engage their rooms at an early date, so that the most desirable locations may be secured. Messrs. W. A. Jackson and F. A. Forbes, of the Telephone and Telegraph Construction Company, of Detroit, have kindly consented to act as a committee on quarters, and a note addressed to either of them will receive prompt attention.

It is not too soon to commence the preparation of papers to be read at the meeting. Members of the Association are earnestly requested to send such papers to the Secretary by the first of August, if possible, so that the Executive Committee may have sufficient time to examine them.

COLLEGE NOTES.

MASS. INSTITUTE OF TECHNOLOGY.

The class recently graduated was the largest ever sent out from the institute, 108. The members are divided among the courses as follows:—Civil Engineering, 25; Mechanical Engineering, 27; Mining Engineering, 4; Architecture, 5; Chemistry, 13; Electrical Engineering, 18; Natural History, 3; Physics, 2; General Studies, 6.

Three of the recent graduates in the Electrical Department, together with one Physicist, return to the institute as assistants next year: Messrs. H. M. Goodwin, F. W. Swantor and W. L. Smith, in the Department of Physics, and Mr. H. E. Hayer to the Mechanical Department.

Mr. Harry W. Tyler, Instructor in Mathematics, who has been acting as Secretary to the Faculty the past year, has been appointed Assistant Professor of Mathematics.

HARVARD UNIVERSITY.

The *Announcement of Courses* for 1890–91 has made its appearance rather late on account of numerous changes in the different courses. In addition, the various departments have issued separate pamphlets containing a more detailed account of the instruction offered. Taken as a whole, the chief feature in the announcement is the division of the courses of each department into three groups: Those primarily for *Undergraduates*; those for *Undergraduates and Graduates*; and those primarily for *Graduates*. The courses primarily for undergraduates are open to graduates, but do not usually count toward any of the higher degrees. To the courses primarily for graduates, undergraduates are admitted only on recommendation of the instructor.

In the mathematical department the courses may be roughly divided into elementary and higher courses. The elementary courses include Trigonometry, Analytic Geometry, Elementary, or Extended Algebra, Solid Geometry, and Special Trigonometry. The higher courses may be divided into five groups; Calculus, Modern Analysis, Quaternions, Mechanics, Applications. The *Calculus* group contains besides two courses specially upon the subject, Spherical Harmonics, Theory of Functions, and a Research course. *Modern Analysis* comprises Analytic Geometry (Modern Development), Determinants, Invariants, Theory of Substitutions, Higher Theory of Equations, and Theories of Functions of Multiple Algebras, and of Qualitive and Logical Algebras. *Quaternions* includes two courses in which the subject is combined with Mechanics. *Mechanics* includes, besides an elementary course, instruction in Analytic Mechanics, Hydromechanics, Wave Motion, and various questions of importance to physicists and mathematicians. *Applications* deals with Navigation and with Astronomy.

In the Physics department the various courses are introduced by courses B and C, which give practice in accurate scientific methods. Course 1 is intended for those who wish to acquire a general knowledge of Physics. Courses 3, 4, and 8 treat respectively of Electrostatics, Electrodynamics, and the Theory and Management of Dynamos. Course 5 is a treatment of Optical Phenomena. Courses 6 and 7 are upon Thermodynamics, and upon the Theory and Management of Heat Engines. In the graduate group are courses 9 and 10 upon the Mathematical Theory of Electrostatics and of Electrodynamics. In addition there are courses of Research Upon Spectrum Analysis, Problems in Mathematical Physics, and Electromagnetism and Heat Conduction. Nearly all of these courses consist of lectures and laboratory work in the fine Jefferson Laboratory, where there is opportunity for one to become a second Sir William Thomson.

In the changes of the corps of instructors, Prof. J. M. Pierce returns to the Mathematical department from his sabbatical vacation; Messrs. Anderegg and Bailey retire from the same department; Dr. Whiting and Mr. Buckingham retire from the Physics department and Messrs. Sabine and Hooper take their places. The Electric Club has adjourned until the end of vacation.

REPORTS OF COMPANIES.

DIVIDENDS.

THE CONGAREE GAS AND ELECTRIC CO., of Charleston, S. C., has declared a semi-annual dividend of 3 per cent.

STOCKS AND BONDS.

SAN ANTONIO, TEX.—C. Guergin, Mayor of San Antonio, will receive proposals until July 19 for the purchase of 5 per cent 20-30 year $1000 bonds, including $25,000 for an electric fire alarm system.

OBITUARY—D. NAPOLI.

It is with extreme regret that we announce the death, on the 29th of May, of M. Daniel Napoli, head of the laboratory of the Eastern Railway Company of France. Born at Naples, on the 27th of April, 1840, M. Napoli came to Paris at an early age, and entered the employment of the Eastern Railway Company as an apprenticed fitter, where his intelligence and great manual skill soon attracted attention. In the field of electricity M. Napoli was the inventor of several skilful contrivances, such as electric clocks and electric alarms. To him also were due some ingenious devices connected with the Reynier-Werdermann lamp. He took an active part in organizing the first Electrical Exhibition of 1881; and his work in connection with the Association Polytechnique gave valuable aid to the popularization of science. M. Napoli was no mean sculptor, and several of his works found a place in the *Salon;* amongst which were busts of Ampère, Gramme, and Alexander Graham Bell. He was Chevalier of the Legion of Honor, officer of the Academy, President of the Société de Navigation Aérienne, and "Secrétaire-fondateur" of the Société Internationale des Electriciens.

INVENTORS' RECORD.

Patents issued July 1, 1890.

Alarms and Signals:—*Electrical Call-Box*, G. F. Gale, 431,141. *Electric Bell*, P. B. Delany, 431,181. *High and Low Water Alarm for Steam-Boilers*, J. McFarlane, 431,271.

Conductors, Conduits and Insulators:—*Protective Covering for Electric Cables*, J. H. Cheever, 431,104.

Distribution:—*System of Electrical Distribution*, L. Gutman, 431,460.

Dynamos and Motors:—*Dynamo-Electric Machine*, C. P. Winkler, 431,184. *Electro-Magnetic Drill System*, H. N. Marvin, 431,170. *Regulation of Dynamo-Electric Machines*, W. Stanley, Jr., 431,216. *Self-Regulating Dynamo-Electric Generator*, W. Stanley, Jr., 431,217. *Self-Exciting Alternating-Current Electric Generator*, W. Stanley, Jr., 431,218. *Dynamo-Electric Machine*, O. B. Shallenberger, 431,235. *Mining Machine*, J. M. Walter, 431,239. *Reciprocating Electric Engine*, C. J. Van Depoele, 431,492, 431,493 and 431,495. *Reciprocating Electric Engine System*, C. J. Van Depoele, 431,494 and 431,496.

Galvanic Batteries:—*Electric Battery*, M. W. Parrish, 431,073.

Lamps and Appurtenances:—*Ceiling-Block Connector for Incandescent Lamps*, L. W. Dillon, 431,038. *Electric Lamp Fixture*, S. Bergmann, 431,320.

Measurement:—*Electric Meter*, J. Couderay, 431,248.

Metal Working:—*Electric Soldering Iron*, C. L. Coffin, 431,439.

Miscellaneous:—*Electric Cut-Out*, L. Daft, 431,035. *Fuse-Block*, J. L. Kimball and H. C. Wirt, 431,062. *Electric Switch*, O. P. Loomis, 431,118. *Multiple Fusible Cut-Out*, L. B. Favor, 431,185. *Multiple Thermal Cut-Out*, L. B. Favor, 431,186. *Electric Connector*, H. Studte, 431,412. *Automatic Cut-Out*, A. L. Haines, 431,516.

Railways and Appliances:—*System of Electric Locomotion*, F. Wheeler, 431,092, 431,093 and 431,095. *Switches for Electric-Railway Systems*, F. Wheeler, 431,094. *Electric Motor for Railway-Cars*, W. McDougall, 431,213. *Suspended Electric Railway and Car*, F. E. Drawn, 431,256. *Electric Railway-Signal Apparatus*, W. Smee, 431,408. *Electric Railway Conductor*, E. Thomson, 431,414. *System of Distribution for Electric Railways*, E. E. Ries, 431,482. *Electric Railway*, R. M. Hunter, 431,519.

Secondary Batteries:—*Secondary Battery*, T. M. Foote, 431,341. *Secondary Battery*, T. S. E. Dixon, 431,417.

Telephones and Apparatus:—*Individual-Call Devices for Telephones*, C. H. Vincent, 431,068. *Telephone Signal Apparatus*, J. A. Seely, 431,531.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

ELECTRIC MOTORS IN NEW ENGLAND MILLS.

For a year or more electrical engineers have been trying, says the Boston *Commercial Bulletin*, to induce New England manufacturers to introduce electricity into their factories as a motive-power to run their machinery, by subdividing the power up into units. It was set forth that such a method would result in a considerable saving to the concern, as less friction would have to be overcome, therefore less power would be required. Generally, the power is centralized, even in cases where electricity is used, one motor doing all the work. By dividing the power, the expense will average less, as current can be used as needed. One or more of the motors can be shut down at will, whereas, when the electric power is centralized, the one motor used must be run for any amount of work to be done. The great hindrance to the division of power is the original cost. Small motors with the same total horse-power as one large motor will cost the most, but it is claimed the saving in running will pay for the difference in a short time. At present, many manufacturers are watching the working of the plant in the M. A. Packard & Co. Shoe Factory, at Brockton, Mass. The electric-power there is divided into 3 units, a 15 h. p. motor furnishing power for the bottoming department, a 10 h. p. motor for the sole leather department and elevator, and a 5 h. p. motor for the stitching department. Formerly, for a year and a half, 1 motor of 25 h. p. capacity run the machinery of the whole concern. By the change, it is claimed, the saving will be 6 h. p. The local electric light and power company, in view of this, have agreed to furnish power for less than when one motor was used. In this plant Sprague apparatus is used throughout.

FORT WAYNE PLANTS.

Mr. H. C. Adams, New York agent of the Fort Wayne Electric Co. advises us that their representative, Mr. A. G. Greenberg, has just closed a contract with the Ilion and Mohawk Gas Light Co., Ilion, N. Y., for a plant of 60 lights of 2000 c. p. each of the new Wood arc system.

NICKEL-IN-THE-SLOT TELEPHONY.

A novel telephone station is being introduced in Connecticut. The instrument cannot be used unless a fee is paid. There are five slots in the machine for the reception of a nickel, ten-cent piece, quarter, half-dollar and dollar, respectively. These amounts cover the rates charged for telephoning to various places in and out of the State. To use the telephone it is first necessary to call up the central, as on an ordinary telephone. The objective point is then asked for, and when this is reached the party who rings up is told to put the necessary fee in the slot. If five cents is dropped in the slot it strikes a bell of a high note, once. Ten cents strikes a bell of the same note, twice. A quarter strikes a bell of a lower note, once. A half dollar strikes that bell twice, while a silver dollar strikes a very low tone "Cathedral Gong."

The Southern New England Telephone Company, has arranged to place a large number of these instruments in Connecticut, as rapidly as they can be furnished.

REYNIER ACCUMULATORS.

M. Reynier has recently exhibited some new accumulators invented by him, which he calls elastic accumulators. The plates, prepared in special manner, are corrugated and placed one against the other, separated by a padding of silica. The elements are placed in elastic receptacles, which are all compressed together. Further details are promised of this accumulator, the gross weight of which is stated as very small for the output.

NEW WESTINGHOUSE ARC AND INCANDESCENT PLANTS.

The Brush Electric Light Company, of Baltimore, Md., having again been awarded the contract for lighting the city, is now obliged to increase the capacity of its central station apparatus. A contract for alternating current machinery for 3000 lights was made with the Westinghouse Electric Company a few days ago. This makes the Baltimore plant one of the largest alternating current central stations in the country.

One of the latest towns in New York state in which the Westinghouse alternating apparatus has been introduced is Tonawanda. The plant has a capacity of 500 incandescent lamps.

The Westinghouse Electric Company is installing alternate current apparatus for a central station plant of electric lighting in Carrolton, Mo. The plant will have a capacity of 500 lights.

The beautiful little town with the romantic name of Crystal Falls, Mich., is about ready for a large sized boom. The first visible sign of its march to progress is the establishment of a central station plant for electric lighting, for which the Westinghouse Electric Company has received the contract to furnish alternating current apparatus of a capacity of 750 lights.

The Westinghouse Illuminating Co., of Schenectady, N. Y., has been making considerable improvement in its central station plant of alternate current electric lighting. A new alternate current arc light machine has lately been added to the plant.

The Westinghouse Electric Company reports the following orders received during the month of June for alternate current central station apparatus: Moundsville, Va., 500; Valdosta, Ga., 500; Newark, N. J., increase, 1500; Cleburne, Tex., 500; Newport, R. I., increase, 500; Hamilton, O., 500; Tacoma, Wash., increase, 1500; Vinton, Iowa, 500; Hiawatha, Kan., 500; Saginaw, Mich., 750; Tonawanda, N. Y., 500; Philadelphia, Pa., 750; Crystal Falls, Mich., 750; Oconto, Wis., 750, increase; Ogden, Utah, 1500; Baltimore, Md., increase, 3000.

Arc lighting apparatus, of the new Westinghouse arc light system, was sold for central station purposes in the following towns: Valdosta, Ga., 40; Ogden, Utah, 80; Schenectady, N. Y., 50; Rockville, Ind. During the month a large arc light plant was also ordered for the Zoological Gardens at Cincinnati.

TESTIMONIALS ON THE INTERIOR CONDUIT SYSTEM.

The Interior Conduit and Insulation Company, 16 and 18 Broad street, have just issued a pamphlet containing a number of testimonials on the merits of their system of wiring. One is from Mr. Edison and another is from Prof. Elihu Thomson. A third is from Mr. F. Kitton, of Buffalo, inspector for the Association of Fire Underwriters there. Mr. Foree Bain also endorses it heartily as a whole and in detail. Mr. W. E. Burnham, of the firm of Eaton, Cole & Burnham Co., whose house has been fitted up with the system, speaks most highly of it. An extract commending the system is also given from a paper read by Prof. Thomson before the National Electric Light Association, and this is followed by extracts from the rules of the various boards of fire underwriters, indicative of the forcible way in which they approve of the system as an ideal and practical means of wiring a building scientifically and safely.

THE WILMOT & HOBBS MANUFACTURING CO.

The above enterprising concern of Bridgeport, Conn., have just issued a new price list of their gong bells. They make bell steel gongs 1¾ to 5 inches in diameter, of a special grade of metal used only by themselves, giving the bells a beautiful clearness of tone. Their bells are also furnished nickel or brass-plated. They have their own rolling mills, tool making, manufacturing, brass and nickel-plating departments, and are thoroughly equipped for putting out the best goods. They do not mount their gongs in any way for the trade, but furnish their gongs simply in the sizes desired, and with a 3-16th inch hole unless otherwise ordered. A large stock is always carried. The company invite correspondence in regard to their specialties.

BUZZING IN TELEPHONES,

According to Mr. R. Appleyard, if a microphone be delicately adjusted and mounted on a resonating box, it will be set into continuous vibration when a sufficiently strong current is sent through it.

In the experiment, the fixed carbon pieces were small blocks with rounded contact surfaces. The vibrators were of square or oblong section, in some cases grooved below, so as to form two points of contact where resting on the fixed blocks.

The time of vibration varied, of course, with the particular vibrator employed; but, by suitably choosing these, almost any rate could be attained, from a steady sway from side to side with the heavier ones, to a decided "buzz" when a slender rod was used.

There is no doubt that the motion is a Trevelyan-rocker effect. The "buzzing" is similar to that heard in a telephone when in circuit with a faulty transmitter, and this latter nuisance is probably, in part at least, produced in the same way.

DOUBLE CARBON ARC LAMPS.

A special dispatch from Pittsburgh of July 5, says:—The Brush Electric Light Company brought suit in the United States Circuit Court to-day against the Westinghouse Electric Company asking that they be enjoined from making, using or selling any electric arc lamps embodying the claims of the plaintiffs. The case is for the alleged infringement of electric lamps, using the double carbon system, designated in this case as "Indianapolis Jenney double carbon lamp," and in which two pairs of carbons are independently adjusted and controlled and burned successfully, one pair of carbons being consumed, or practically consumed, prior to the establishment of the arc and the burning of the other pair.

WESTERN TRADE NOTES.

KNAPP ELECTRICAL WORKS, 54 Franklin street, Chicago, report business as exceedingly good. During the recent hot spell the call for their motor fan outfits has been very large. There is no let-up on the quantity of Grimshaw white core and other specialties sold, and Knapp annunciators are also in large demand.

BAIN LIGHTNING ARRESTER.—A highly novel and ingenious lighting arrester has just been invented by Mr. Foree Bain, of Chicago. The principles employed in its operation are entirely new, and appear to be full of merit. It was seen in practical operation, a 100 light incandescent machine being used for the purpose, and the results were highly satisfactory.

MR. J. E. WILSON, of the Western Power Construction Company, Rookery, Chicago, who handle the famous McIntosh Seymour engines in the West, has just returned from a flying trip to Boston, whither he went on important business. He made but a very brief stay at the Hub, as he had many important matters to look after here, the company's business being unprecedented in its volume and extent, although it has been in the field but a short time.

THE L. J. WING COMPANY, of 96 Lake street, Chicago, are having quite a run on their Disc fan. These fans may be operated by any power, but an electric motor is preferable, being so adequately fitted to fill all requirements. They manufacture a very handsome disc fan and electric motor combination. The motors are built as a part of the fan and require a minimum power for driving. They do not obstruct the light and run practically noiselessly.

W. CALKINS & SON, 175 Munroe street, have opened a Chicago office of the well and favorably known Rockford Electric Manufacturing Company, of Rockford, Ill., manufacturers of the Mayo electric light and power apparatus. This company furnished all the motors for running the printing presses and other work in the *Inter-Ocean* building, and this plant is giving the best of satisfaction. Mr. Calkins has been prominently connected with the company from its start, and in the management of the Chicago office many advantages will accrue to all concerned. The company manufactures a complete system of arc and incandescent lighting and electric power apparatus.

THE ELECTRIC MERCHANDISE CO., 11 E. Adams street, are finding a large and ready market for their electric railway specialties. They are, if we are not mistaken, the only supply company of the kind in the country that confines itself exclusively to the manufacture and vending of supplies solely for electric street railways. Mr. Mason and his staff are thoroughly cognizant of the requirements in this line, and it is safe to say that to no better development in electricity could they have turned their attention, as the field is almost infinite, and success is greatly dependent on the minute details of construction and apparatus. They are completely independent and tied down to no particular system, so that all the improvements which they have and will introduce are open for adoption by all roads operating with electric power.

ROCKFORD ELECTRIC MANUFACTURING CO.—The development of the business of this company has been so rapid, that no sooner had they arrived at their maximum efficiency in the organization of their working force in their present large quarters than they found it absolutely necessary to expand and expand at once. With this end in view arrangements are now about consummated whereby they will shortly occupy two large factory buildings near their present site, where they will have room for 500 hands, or more. Another section of the town was at one time talked of as a location for their new works, and the "boomers" in the vicinity offered the company a large amount in spot cash to locate near them; however, as this would have necessitated the use of steam, they have decided on occupying a position near their present works where water power is excellent. The new factory will be equipped with the latest and most improved machinery and tools, under the direction of General Manager Eaton, and under the personal supervision of Mr. George Mayo.

J. LANG & CO., 44 Michigan street, Chicago, are remarkably busy turning out their well-known switches, gas attachments and other specialties, now so largely used by electrical companies; both their steam and electric departments are taxed to their full capacity. They are at present manufacturing, amongst other work, four switches of 1,000 amperes each for the Chicago Edison Company's central station on Adams street, where they already have in constant operation more than one hundred of these switches, ranging in capacity from 600 to 1,000 amperes; also two switches of special design for the Belding Motor Company to control two large electric motors for A. Booth & Sons, the fish packers of this city; twenty Andrews switches of 250 amperes each; three 3-pole switches, and six Andrews switches, which will be used by the Chicago Edison Co. in the Wisconsin Central depot, of a capacity of 400 amperes each. They have put out some 60,000 of their combination gas attachments in the past two years. They have a fine assortment of orders on hand for their automatic water gauges and Chicago free-seated gauge cocks, and are altogether well satisfied with the business on hand and the wonderfully bright prospects for the future.

NEW ENGLAND TRADE NOTES.

MR. DAVID DUNN, accompanied by a number of Pittsburgh gentlemen favored Boston with a short visit this week, and doubtless felt on his departure that he had been mercifully allowed to sojourn if only for a few days once more "in God's country."

THE STANDAND ELECTRIC COMPANY OF VERMONT, has recently sold a 100 light plant to the Winnipesaukee Paper Company, at Franklin Falls, N. H., and a 100 light plant to the Fibre Wood Company, Plymouth. The Standard Company have a good dynamo, and are now making preparations to push it more energetically than ever during the summer and fall.

THE GOULD & WATSON COMPANY continue to manufacture a vast number of insulators in various forms out of their successful material, moulded mica, and report business as extremely brisk. Besides these insulators Messrs. Gould & Watson do an enormous business in mica, and are selling to all the electrical companies, for various purposes, being direct importers from India, of the very best quality for high insulating properties.

MR. W. H. CLAUSEN, electrician of the Boston office of the Gold and Stock Telegraph Company, has invented a new system of winding the small motors used for running the transmitters, which operate the numerous stock tickers in brokers' offices, by which he increases the efficiency of these motors to 90 per cent. The motors will run with 36 milliamperes of current, being only about one-sixth of the current hitherto used. The principle can be applied to all small motors up to one horse-power with good effect.

THE NEW ENGLAND WIRING AND CONSTRUCTION COMPANY are wiring the Ponemah Mills, Taftsville, Conn., for a 1,000 light Thomson-Houston plant, and are installing a commercial plant of 600 lights in Groveton, N. H., doing, besides, all the outside and inside wiring. They are also engaged in wiring Dr. Burgergreen's house in Lynn, Mass.; a private residence in South Framingham, Mass., in which the interior conduit system will be used; and are also fitting up the Temple Club, Boston, and a fine residence in the Back Bay district, Boston, with the interior conduit system, wiring and fixtures.

THE NATIONAL TELEPHONE MANUFACTURING COMPANY are creating quite a sensation and boom in their business by the wholesale distribution in post office boxes of what they term a National Mail Card. They are to be congratulated on their unique scheme of advertising, and the large amount of success which has recently attended them. Their business was never so good as at present, and they are sending their non-electric telephones, which time has proved to them to be most successful, not only all over this country, but to many foreign countries, where they are received with great satisfaction.

THE HOLYOKE MACHINE COMPANY, OF WORCESTER, Mass., have just completed large additions to their factory and foundry, and have built a new office and draughting room on the second floor. They are at present engaged in a great deal of heavy work in turbine wheels and shafting, and have recently equipped the electric railway stations in New Orleans, Indianapolis and Waltham, and only a short time ago finished equipping the Worcester electric light station, one of the finest electric light plants in the country. The Holyoke Machine Company do only first-class work, and are exceptionally well prepared to execute the largest orders on very short notice.

PETTINGELL-ANDREWS COMPANY.—The business of Messrs. Pettingell, Andrews & Company has been formed into a corporate company, and will hereafter be known as the Pettingell-Andrews Company. The company has been organized with a capital of $300,000, and the officers of the company are Mr. F. E. Pettingell, President; Mr. D. A. Andrews, Jr., Vice-President; Mr. D. A. Andrews, Treasurer, and Mr. C. B. Price, Secretary. The business of the company continues to increase at a very rapid rate, but they will still handle promptly all orders for electric light and railway supplies. They retain the sole and valuable agency of the Okonite wires and cables, which are becoming more popular than ever, and have recently been appointed New England and Eastern Canada agents of the Bryant Electric Company, of Bridgeport, makers of the famous Bryant switch.

SEEING BY ELECTRICITY.

A cable dispatch from London of July 5 says:—Prof. Hughes exhibited at the Penny Postage Jubilee a novel instrument which enables people using a telephone to see the speaker at the other end of the wire while talking and listening to him. This is accomplished by the appearance of an image of each of the speakers, which looks like an animated colored photograph. It is a very curious thing, and has attracted a good deal of attention.

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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers*

VOL. X. NEW YORK, JULY 16, 1890. No. 115

The most important—not to say the only—rule for the genuine investigation of nature is to remain firm in the conviction that the problem before us is to learn to know phenomena, before seeking for explanations or inquiring after higher causes. As soon as a fact is known in all its relations, it is therein explained, and the problem of science is at an end.—Julius R. Mayer.

BANISHING THE STEAM PIPES.

AN order has been issued by the Board of Health to the New York Steam Company, to suspend its service at certain points on Broadway and Wall street. This action is taken as the result not only of the many recent accidents and explosions but of the facts as to dangerous heating of gas pipe joints, bad smells, escape of steam, etc., brought out by an investigation regarding the manner in which the system is working. It does not follow that the service in question will be suspended immediately, but it is not at all unlikely that hereafter there will be a decided restriction of the company's operations.

In this matter, as in most others of the kind, there has been much unfair complaint and exaggeration. Steam distribution has not been all that fancy formerly painted it; neither has it been quite a wholesale failure. In many respects it has been a success, but to-day it is not the necessity it once was. Except in a few instances where the steam is used for heating, it could be dispensed with, and its absence would not be felt or noticed, unless for the better. In other words, all the power service that is now being given over a large area by small steam engines can be given more safely, more cheaply, more expeditiously and more conveniently by electric motor. The steam mains are everywhere paralleled by electric mains; and while a partial rupture of the steam mains means a total disablement of large sections of supply, the electric circuits now so ramify and interlace that it daily becomes more improbable that even a single block could be cut off from its central station except by deliberate choice.

Moreover, as has just been remarked, the electric motor outranks these small engines in economy. It is simply true that while efficiency is not expected in a 1 or 2 h. p. engine, it is looked for and is obtained up to a very high point in electric motors of such a size. The charges for service will also stand comparison. We know of more than one instance of late, wherein the motor has supplanted the engine with an enormous saving to the user of the power. There are, of course, many incidental advantages, but the dollars-and-cents argument is the one that receives the greatest attention and commands the most respect. New York does not claim, however, to be singular in that regard.

For such reasons as have thus been intimated, it seems to us that the days of steam supply in this city are limited. Our excellent contemporary, the *American Gas Light Journal*, says that the troubles are due to the "infernal recklessness" of the Steam Heating Company; but the service may be bad and inadequate without being either "infernal" or "reckless;" and it will lose its patronage chiefly because a better method of power distribution has been found, namely, one of confining all the nuisances of steam generation and expansion to one central station, yet delivering its power instantaneously in any quantity at the point of consumption, in the guise of harmless current that has traversed a cold and silent wire the thickness of a lead pencil.

One point, however, has yet to be dealt with by electrical inventors and engineers. We refer to the use of the steam for heating as well as power purposes. This double necessity will not escape the notice of far sighted men; and then another step in advance will have been made.

ELECTRICITY IN METAL WORKING.

WHEN, some fifteen years ago, Sir Wm. Siemens constructed a small electric furnace and succeeded in melting steel by the heat of the arc, the possibility of applying the current for smelting purposes was accepted, but its practical application to any considerable extent was considered to lie far in the future. But in less than one-half of the usual time required for an idea to become firmly established and fruitful, we find the current applied in numerous instances for smelting purposes, principally for the production of aluminium. Going but a step beyond, we note its application to heating for the welding of metals.

To the electric drills now coming into general use must be added the electric riveter, a very ingenious arrangement which is described in another column. But the inventor, going still farther, applies the current not only to obtain the finished product, but to test it as well, after its completion. The most recent application of this kind, the schiseophone, which we illustrate elsewhere, is a beautiful combination of elements, both acoustic and electric, and has already found a field of usefulness, not merely in the testing of war material, but in one of the most important details of railway construction—the rails. With such an instrument in use in every bridge shop, there would be little excuse for bridge disasters, and the present method of testing one sample bar out of 50 or 100 will be looked back upon as a barbarism and a misdemeanor.

DEFECTS IN PHYSICAL TERMINOLOGY.

With the rapid strides that science has made during this century, it ought not to be a cause for wonder if many of the early explanations of physical phenomena varied considerably from those current to-day. But, on the other hand, it cannot be denied that even at the present time much diversity of opinion, not to call it uncertainty, exists on many important facts in physics; and the confusion is such as to require a thorough revision or unification of physical terminology. This is well shown in Prof. Dolbear's article on this subject on another page, in which he quotes from a variety of authors, no two of whom exactly coincide in the definition they give of the phenomenon of heat. This diversity exists in a like manner with reference to electricity. When to this is added Dr. Lodge's dictum that the very term "electricity" may have to go, in the light of future investigation, it will be seen that physical terminology, though sadly in need of standardization, as it were, may be a subject still allowing generous and even heterodoxical latitude of opinion. While, in this issue, merely pointing out the diversities and discrepancies existing, Prof. Dolbear in the succeeding part will show in what manner considerable uniformity may be attained in physical terminology based on well recognized phenomena or established theories.

THE RAILWAYS OF TO-MORROW.

The daily papers have been busily discussing during the past week a remark said to have been made by Mr. Henry Villard just before he sailed for Europe, that it would be well to go cautiously in respect to certain expenditures for locomotives, because it was probable that within a few years the motive power of every railroad in the United States would be changed. Our newspaper friends think that Mr. Villard is cognizant either of some new process for storing current or has had his attention called to some invention for generating current directly from the heat of fuel.

But neither of these alternatives or conjectures is necessary to explain Mr. Villard's remark—if he made it. There is surely enough promise in the work already done by electricity on street railways and long rural roads to warrant the utterances quoted, or something pretty near them. Already over 25 per cent. of the street railroads of the country are electrical, and this proportion is doubled among the new roads as they spring up. Another feature of the work is that many places now lying close together have each their electric roads and are being supplied with electric links, so that practically for miles and miles there is a continuous electric service.

We have heard during the past few days of a well matured plan for an electric road between two of our largest cities about a hundred miles apart. Along the line of that road are already several existing electric roads, and much less work than one would at first suppose is necessary to complete the whole track and make the supply of current uninterrupted from one end of the road to the other. On such a road, cars would be running all the day through, every few minutes, and a man who used it would no more be the slave of a time table than he now is if traveling on the New York elevated road or the Brooklyn horse cars.

CURRENT AND FRICTION.

The publication in our columns of the experiences and results obtained by various experimenters in the effects obtained by the passage of the current between two moving surfaces has encouraged others to experiment on similar lines, and in this issue we give the results of work done at the works of the Thomson Electric Welding Co.

It may probably be taken for granted that the increased friction noted is invariably accompanied by, and is due to, the generation of heat at the surfaces in contact; and this is confirmed by Mr. Schmidt, who shows that the attraction due to the electro-magnetic action is practically negligible. But it will be noted that Mr. Schmidt's results differ in some respects from those heretofore obtained and show that considerable difference exists between the "electric friction" of repose and that between moving bodies. Thus while the coefficient increased with increasing current with the surfaces in repose, it actually decreased with the surfaces moving. This latter result is in direct variance from the results obtained by previous experimenters, but attention must be drawn to the fact that Mr. Schmidt's experiments extended over a wider range of current and surface than has heretofore been employed and that they relate exclusively to surfaces in sliding contact. While we are not informed as to the maximum strength of current employed by Mr. Ries, the latter's work has been almost entirely confined to rolling surfaces, having but a mere line of contact and in which the current density must be exceedingly high. That there may be some differences due to these different contacts is not improbable, and further investigation in these directions is eminently desirable. Mr. Schmidt's results, however, agree with the phenomenon pointed out by Mr. Ries, that the oiling of the surfaces is followed by an increase in friction.

The Demand for Small Motors.

With the thermometer a hundred in the shade, it need not be wondered at that a gasping cry has been heard all over the country for electric fan outfits. The demand during the past week for small motors and fans has been almost fabulous, and not a manufacturer has been able to keep up with the orders raining in from every quarter. An order in the morning for a dozen motor outfits has been duplicated by telegraph at midday and quadrupled at night with an humble, heartrending supplication for immediate delivery.

Series Railway Data.

The data published so far relative to the power and current required by electric street cars operated in parallel is now familiar and gives a fair basis for the estimation of the plant necessary to operate such roads. But up to the present time no such data have been forthcoming with regard to cars operated on the series system, the small number of such roads being probably accountable for this. Our readers will therefore be greatly interested in the figures presented by Mr. O. T. Crosby in another column, giving the results of some tests made on the Short series railway at Huntington, W. Va. From these it will be noted that the consumption of power does not differ materially from that required by cars run in parallel on roads of similar character as regards gradients.

THE INFLUENCE OF CURRENT ON THE FRICTION OF SLIDING SURFACES.

BY LOUIS M. SCHMIDT.

The influence of the passage of current upon the friction of sliding surfaces was recently investigated at the laboratory of the Thomson Electric Welding Company, the currents employed being higher than are ordinarily used, except for welding purposes. An ordinary welder with very few changes constituted the principal part of the apparatus employed. The secondary of the welder consisted of almost a complete circuit of solid copper. The break was in a portion that was horizontal with a V-shaped cross-section, with the sides inclined 45 degrees from the vertical. The V on one side of the opening was directly in line with that on the other side, thus forming two sets of guides in line with one another.

At each side, supported by the guides, was a block of copper, V-shaped at the base to correspond with the guides. These blocks ordinarily support the clamps which hold the stock to be welded. These two blocks were united mechanically by cords and electrically by copper conductors made of copper strip. To the block on one side was attached a

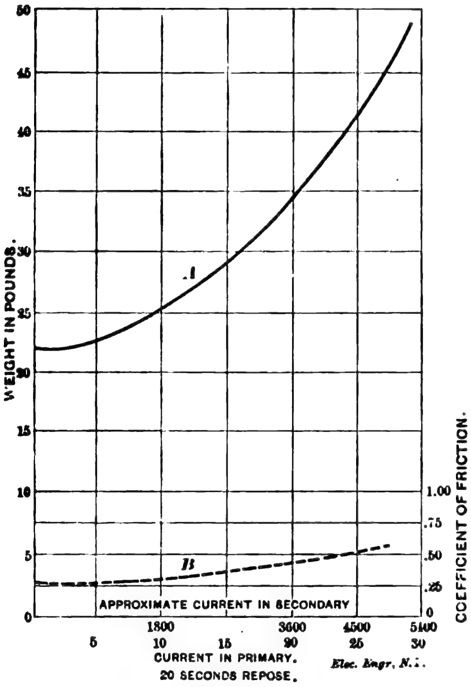


FIG. 1.

lever by a cord, by means of which the blocks could be drawn toward the corresponding end of the guides. To the other block was attached a cord which passed over a pulley. To the end of this cord was attached the weight required in a given case to overcome the friction and start the blocks in motion.

The current in the primary was read each time. The ratio of the turns in the primary to the turns in the secondary was 180 to 1. Assuming the ratio of the current in the primary to the current in the secondary to correspond to the ratio of the turns, the current in the secondary is thus approximately obtained.

Each contact surface contained 15 square inches of surface, making 30 square inches for each block, across which the total current in the secondary passed. Thus, with a current of 4,500 amperes, there would be 150 amperes per square inch of surface. The current used was of 100 alternations, or 50 periods per second.

In the accompanying diagrams the abscissæ represent current in primary or secondary as noted on the same. The ordinates for the full drawn curves, with dimensions on the left, represent the corresponding weight in pounds necessary to move the blocks. The ordinates for the broken line curves, below the full line curves, with the dimensions on the right, represent the coefficient of friction corresponding to the current as represented by the corresponding abscissæ. These values were obtained by dividing the weight required to move the blocks by the weight of the same, which was taken at 80 pounds.

Trials were made with, and without, repose, with quite different results so far as the investigation was extended. With repose of a few seconds with the current on, begin-

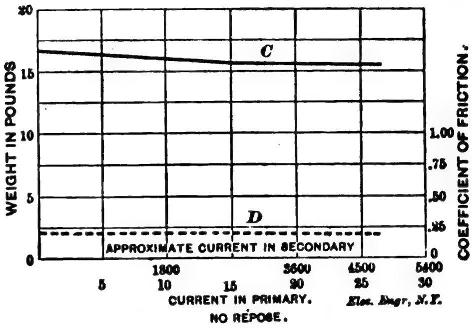


FIG. 2.

ning with the smaller currents and gradually increasing, the influence of the current at first was slight; but as the current was increased the influence increased at a rapid rate. The curve A, in Fig. 1, was plotted from results taken, allowing 20 seconds repose with the current on before the weights were applied. The corresponding coefficient of friction curve B is shown below A.

To investigate whether the influence was due to heating effects only, or was augmented by magnetic effects mani-

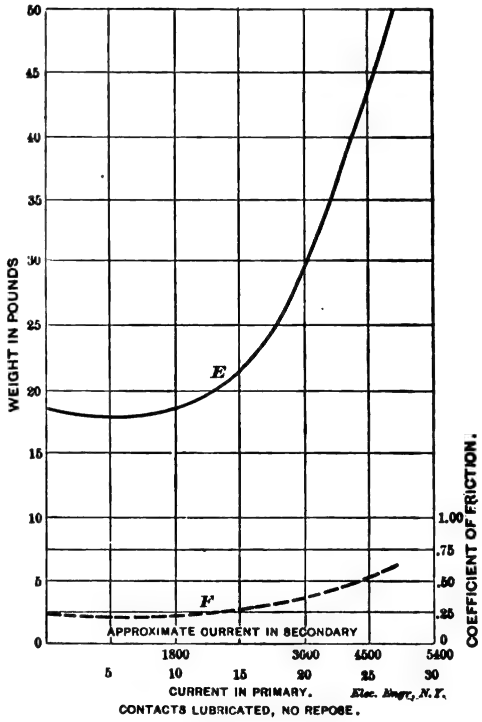


FIG. 3.

fested only while the current was flowing, a few trials were made leaving the current on during 20 seconds repose, but opening the circuit just before applying the weights. While it was found in a given case that the weight required was less than when the circuit remained closed, the difference was not more than might be attributed to loss of heating effect by the interruption of current.

Curve D, in Fig. 2 was plotted from results obtained without allowing repose. The influence of the current, so

far as tried, was slight, but, contrary to the previous case, it was found to decrease the friction.

Trials were also made with the contact surfaces lubricated. The lubricant used was mineral oil, such as is used for bearings. With comparatively small currents the influence was not appreciable. The turning point was, however, soon reached, when it was found that the rate of increase of the effect was rapid with a moderate increase of current. As the effect was quite variable, it was difficult to obtain very accurate results. Curve E, Fig. 3, however, shows very well the general tendency.

Results similar to the above were also obtained with the two blocks united by a piece of wrought iron held at the ends by the clamps which were on the blocks. Thus the iron formed both the mechanical and the electrical connection between the blocks. On account of the rigidity of the connection by this method, there was considerable liability at times that some of the surfaces might not remain in good contact even if once so arranged, for the effect of expansion of the stock due to heating and the mechanical strains to which the parts are subjected would have a tendency to throw the parts out of line. These objections are eliminated by the use of a flexible connection.

The deductions that may be made from the above results are that the influence of the passage of current upon the coefficient of friction for sliding copper surfaces is :

First, to increase the coefficient of friction of repose.

Second, to slightly decrease the coefficient of friction of motion within the limits tried, about 100 amperes per square inch of surface.

Third, that the effect of oil with other than weak currents relatively to cross-section of conducting surface would be to largely increase the coefficient of friction.

THE QUANTITY OF ELECTRICITY IN A LIGHTNING FLASH.

Assuming that a normal flash melts a copper conductor of 5 sq. mm. section, Prof. Kohlrausch proceeds to calculate the quantity of electricity involved. A metre of wire of this size weighs about 44.5 grammes, and 6,700 calories are required to raise it to the fusing point of 1,200° C. A conductor of 5 sq. mm. section and 1 metre in length has an average resistance of .01 ohm between 0° and 1,200°. A current, C, in time, t, will therefore develop in it $.24\ C^2 \times t \times .01$ calories. Now it may be assumed that t varies between .001 and .03. Assuming the quantity of heat to be 6,700 calories, we get for C 52,000 and 9,200, respectively, for the two values of t. The quantity of electricity would therefore be 52, or 270 coulombs, and would be sufficient to decompose 5 and 25 mgr. of water respectively. Or, taking another illustration, if the quantity of electricity could be stored and used to supply a 16 candle-power incandescent lamp, 35 and 7 of the flashes, respectively, would be required per hour. Palaz's investigations gave for a flash 28 coulombs.

VOLTMETER READINGS ON THE SHORT SERIES ROAD, HUNTINGTON, W. VA.

BY O. T. CROSBY.

The following voltmeter readings recently taken by me show the difference of potential between the terminals of a Brush motor, used for propelling a street car at Huntington, W. Va. This motor is in series with another similar motor propelling a second car, and in series also with a stationary motor and a special arc lamp. The current—furnished by a Brush dynamo—is nearly constant at 34 amperes. The car motor was mounted on the front platform, its horizontal plane of symmetry lying nearly in the plane of the car-floor. Spur-gearing connects the armature with the front car-axle. Rotation of the brushes around the commutator effects the desired variation of speed. Short-circuiting is resorted to for a long stop. Stopping just long enough to let one passenger get on or off quickly is effected by the brakes, the brushes being thrown into such position as to reduce torque. Readings were taken every 30 seconds with an Ayrton & Perry voltmeter graduated to 200 volts. Fair approximation can be made to 250. Occasional readings above that figure are rough estimations.

Length of run = 7.0 miles = 3.5 miles and return. Average speed = 8.4 miles per hour. Average number of passengers = 15. Approximate weight of car complete = 9,000 lbs. Maximum grade = 4% ; grades generally easy.

Track in good condition ; principally of T-rail.

READINGS.

Trip out.		*Trip in.*	
120	175	120	20 (stop.)
——	210	75	180
——	170	95	165
110	90	0 (stop.)	150
——	85	155	
125	20 (stop.)	180	
——	20	210	
140	110	190	
——	90	120	
110	60	100	
90	170	130	
210	115	0 (stop.)	
190	230	140	
——	300 (?)	185	
120	185	200	
145	200	145	
——	300 (?)	210	
150	180	180	
110	105	300 (?)	
250 (?)	115	195	
185	190	300 (?)	
——	145	200	
200	0 } stop.	300 (?)	
160	0 }	210	
300 (?)	220	100	
——	200	140	
10 (stop.)	180	175	
250 (?)	165	125	
250	100	210	
75	185	70	

Average d. p. = 155.5 volts. Average h. p. from wire to car = 7.07. H. P. hours per car mile = 0.84.

Similar figures for cars running "in parallel" have now been quite frequently presented. I have seen none for the few "series roads" in operation. Hence this communication.

THE SCHISEOPHONE.[1]

It is of vital importance in certain industries to be able to discover the flaws that exist in the interior of blocks of metal, and which, at a given moment, may put the security of a piece of work seriously in jeopardy. Hardened chrome steel shells, for example, present numerous centres of tension. The molecules, irritated against each other (so to speak) by the tempering, tend to separate and to leave spaces between them. Shells with such an internal structure are worthless, and their point breaks against the armor plate that they are intended to pierce. In most cases, there is nothing to indicate such flaws, and the human ear is too dull an instrument to perceive the differences in sounds given by the blow of a hammer, whether it be upon a perfect or a defective part. What has just been said about shells applies to all pieces of metal that are to be worked—gun tubes, axles, driving-shafts, rails, etc.

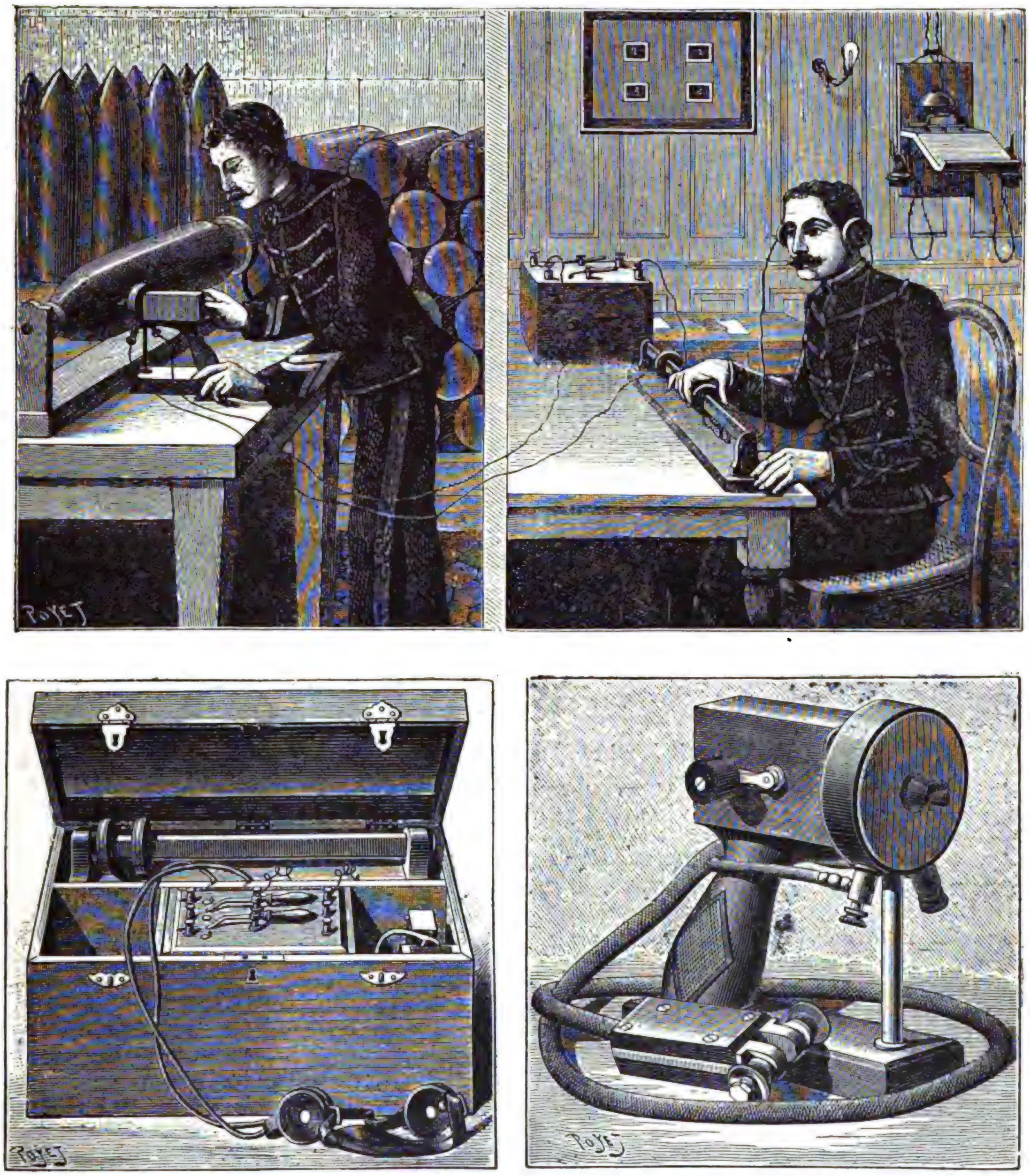
Captain Louis De Place, professor of fortifications and of applied sciences at the School of Cavalry, has had recourse to the microphone, employed under certain conditions, for the detection of flaws in metals. His apparatus, as will be seen, is an ingenious application of Prof. Hughes' induction balance. Captain De Place, combining the mi-

1. *La Nature.*

crophone with a mechanical striker and a sonometer, has produced an instrument which he calls a schiseophone (from Gr. σχίσις, "fissure," and φωνή, "sound" or "voice"), which permits of recognizing the difference in sound given by the striker, whether it strikes a perfect or an imperfect part.

The diagram, Fig. 4, shows the operation of the apparatus in the verifying room and the listening chamber is represented in Fig. 2. At B we have the block to be examined, and in which we shall suppose that there is a flaw, *t*. A microphone of annular construction and of special form is traversed by the striker, F, which is actuated by a very sound that will continue to diminish in measure as the operator widens the space between the coils. At a given moment, perfect silence will be obtained. If the examination be continued with the mechanical striker, and the latter hits at *p′*, a place where there is a flaw such as *t*, the interior flaw or vacuity will form a sounding box, the sound will increase, the microphone will cause the resistance of the external circuit to vary, and the sound will be re-established in the telephones. The internal flaw will therefore be made known.

The schiseophone is inclosed in a box, Fig. 3, having four compartments which contain (1) the audiometer and



FIGS. 1, 2, 3 AND 5.—THE SCHISEOPHONE, OR DETECTOR OF FLAWS IN METALS.

simple mechanism (not shown) that gives it an alternate to and fro motion. A battery, P, is placed in the circuit of the microphone and of an inducing coil, B, fixed to the zero point of a graduated rule, R R′. Upon this latter moves the induced coil in whose circuit there is a pair of telephones provided with a spring that permits of fixing them upon the head.

It will now be understood that if the striker hits a perfect part such as *p*, the induced coil, being in contact with the inducing one, the telephones will produce a certain its bobbins; (2) the telephones; (3) the striker and its microphone; and (4) six dry elements of the De Place type. These elements are in threes in series, and a commutator upon the cover permits of changing the batteries every quarter of an hour in order to prevent polarization. The special absorbent discovered by Captain De Place, and called *melasine* by him, presents no internal resistance. It does not dry up, prevents climbing salts, and keeps the zincs in a permanently clean state.

Some experiments were recently made at Ermont, the

stock depot of the Northern Railway Co. The schiseophone was kept in operation for a whole week, showing the company's engineers the internal flaws in rails. The location of the flaws was at once marked with red paint. In the afternoon, the rails were broken by a power hammer at the places indicated, and, in every instance, the breakage brought fissures of more or less importance to light.

In order to get proper indications from this instrument, it is important that the same operator shall always have the telephones, and that the apparatus be so maneuvered as to permit the striker to rebound upon the metal. Finally, in practice, it is preferable not to draw back the induced coil

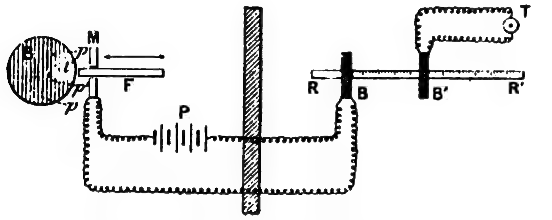


FIG. 4.—CIRCUIT OF SCHISEOPHONE.

until perfect silence is obtained, but to allow a slight sound to remain in the telephone. It is the increase of such sound that reveals the internal flaw.

It will be easily conceived that it is of prime importance for railway companies to have none but sound rails. The defective ones break and cause derailments, which, aside from the personal accidents that accompany them, prove very expensive both on account of the indemnities to be paid and of the deterioration of the *materiel*. The schiseophone provides a remedy for this.

THE SANFORD ELECTRIC PROTECTOR.

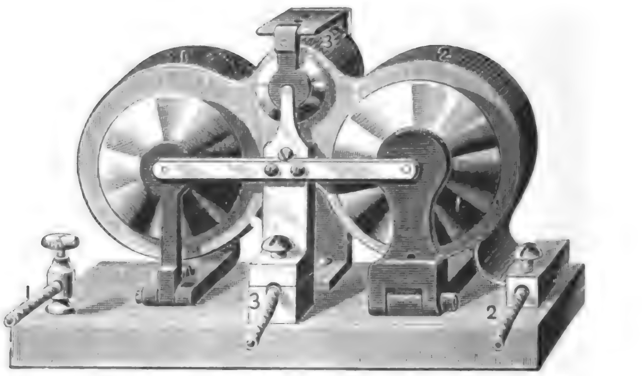
THE introduction of electric light and power circuits soon made it apparent that where these lines ran in proximity to telephone, telegraph or fire alarm wires, means had to be provided for protecting the instruments connected with the latter from the effects of crosses. The heavy currents coming in led to frequent destruction of the more delicate instruments and a variety of safety devices have been designed to prevent this, embodying safety-fuses and cut-outs of various types.

A recent instrument designed for this purpose by Mr. C. E. Sanford embodies a number of novel features which make it worthy of notice and in which the aim of the inventor has been to provide an apparatus which shall have a large range of action so as to protect for the smallest as well as the heaviest currents, and which at the same time is always ready for action without requiring any attention whatever.

The manner in which these requirements are fulfilled is shown in the accompanying engraving which illustrates the Sanford protector. As will be seen, it consists of three coils, 1, 2 and 3, each of which is wound with a different sized wire, and so arranged that they will attract their respective armatures with different strengths of current. Thus the incoming wire enters at the binding post 2, passes through the coil 2 and is then connected to the core of that coil. The frame is bent around in U-shape, and has hinged to it the armature of coil 2. From the frame of coil 2, the circuit passes to coil 1, is connected to its core and armature in a similar manner, and from there the circuit leads to and through coil 3 and out at binding post 1 to line.

The small coil 3 is wound so as to attract its armature when the current reaches ¼ ampere and maintains its connection until the current reaches 4 amperes. The coil 1 attracts its armature at 2 amperes and protects up to 30 amperes; while coil 2, which is wound with heavy copper ribbon, begins to act at 20 amperes, and has a capacity of 250 amperes.

The action of the instrument results in the cutting out of the apparatus to be protected by shunting or grounding, and this is accomplished in the following way. It will be noticed that the ends of the coils are embraced by, but insulated from, a spectacle-shaped copper plate which is supported by, and in metallic connection with, the standard 3 connected to ground. Now, supposing that a cross occurs on the line to be protected, and a current of more than normal strength comes in. It passes in succession through coils 2, 1 and 3. As soon as it attains a strength of ¼ ampere it attracts the armature of coil 3 which comes in contact with the grounded plate and thus carries the current off around the instrument to be protected. Now, if the current should increase, at the instant it reaches 2 amperes, the armature of coil 1 is attracted to the ground plate, which action not only cuts out the instrument to be protected, but at the same time shunts the fine coil 3, thus protecting it also from destruction. When the current


SANFORD ELECTRIC PROTECTOR.

has reached 20 amperes, finally, coil 2 comes into action, and similarly cuts out both the other coils, whose armatures drop back to their original positions. As coil 2 is capable of carrying a current of 250 amperes, it is evidently able to take care of the heaviest stray current which is likely to come in on any line.

It will be evident from the construction, that as soon as the stray current is removed from the circuit, the instrument assumes its original condition, takes off the ground, and is ready for the next operation.

We have seen the instrument in operation at the office of the National Electric Protector Co., of this city, of which Mr. C. E. Sanford is the lessee, and had occasion to witness it act under a variety of conditions with eminently satisfactory results. As the entire resistance of the protector is less than one ohm, it entails practically no deterioration of the service, while, as was demonstrated, it is able to protect both sides of the system.

A PREDICTION OF THE PHONOGRAPH.

THE Baroness Althea Salvador, in a recent letter to one of the New York papers, from Paris, says:—"'There is nothing new under the sun!' one cannot help exclaiming after reading the proofs of Louis Pauliat, Senator, that the phonograph was known in 1650. In this year Cyrano de Bergerac, an author and famous duellist wrote, 'A Journey in the Moon.' His guide, obliged to leave him some moments, lends him two books, and Cyrano de Bergerac takes one which has a cover like a box. Here it is.

"At the opening of the box I found I know not what, in metal, full of little springs and imperceptible machines. It is a book, but a miraculous book, with neither leaves nor characters; it is a book to read which eyes are useless, for one needs only ears. When I wished to read, I bound the the box with all kinds of little nerves that I found, then I turned the needle on the chapter to which I wished to listen, and I heard, as from the lips of a human being, most remarkable facts of intense interest to a student."

According to M. Pauliat here is the description of a

phonograph similar to the one invented by Mr. Edison. It will be remembered that like fanciful anticipations were made of the telephone.

ON THE RECTIFYING OF ALTERNATE CURRENTS BY SYNCHRONIZING DEVICES AND THE INFLUENCE OF SELF-INDUCTION THEREON.

BY CHAS. STEINMETZ.

It is well-known that a current which has always the same direction can easily be derived from an alternate current circuit by means of a synchronyzing device; that is, a commutator whose revolutions have a constant ratio with the periods of the alternate current, and which may be set and kept in synchronism by this same current.

But the derived current, although often miscalled a continuous current, differs considerably from the continuous currents of our dynamos, its value varying between zero and a maximum. Therefore it may be more properly called a *pulsating current.*

While on a true continuous current circuit self-induction will have no influence at all; on such a pulsating current the counter electromotive force of self-induction will cause a series of phenomena, the worst of which will be excessive sparking at the commutator, especially when the pulsating current is used for exciting electro-magnets.

Such pulsating currents are largely used for exciting the electro-magnets of so-called self-exciting alternate current generators, and also of synchronous motors, like that of Ganz & Co., which has attracted considerable attention lately, since the competitive tests at Frankfort-on-the-Main proved its efficiency to be very satisfactory.

Very little is known as yet of the behavior of these pulsating currents. Only a short time ago it was wrongly asserted before a meeting of expert electricians, that the magnetism of electro-magnets, which are excited by pulsating currents, could sometimes become zero, whereas the truth is, that the value of the magnetism will oscillate around the average or mean value of the magnetizing current, with an amplitude more or less diminished by self-induction; therefore, in the alternate current transformer it will pass through zero twice in each period (zero being the average value of the alternate current), but in the electro-magnets excited by a pulsating current it can never become zero, the mean value of the current being a value different from zero; the oscillations of the magnetism would just touch the zero line, if their amplitude were not reduced by self-induction. It seems to be worth while, therefore, to subject these pulsating currents, and the phenomena connected therewith, to an analytical treatment.

In order to consider what happens in such an electric circuit, let us first suppose the electromotive force of the dynamo-generator (the impressed electromotive force of the circuit) to be a true sine curve, and leave out of consideration the influence of hysteresis and of eddy-currents.

The time t may be counted from the moment when the value of the impressed electromotive force equals zero, the time of one-half period being $= T$, corresponding to an angle of 180°, if we represent the whole period by one revolution, or 360°.

Then the equation of the impressed electromotive force is:

$$e_0 = E_0 \sin \pi \frac{t}{T}, \qquad (1)$$

where E_0 means the maximum value of the impressed electromotive force of the dynamo; for the sine curve $E_0 = C_0 \sqrt{2}$, C_0 being the "effective" electromotive force of the dynamo.

Now the connection and disconnection of the electro-magnet with the main-circuit, that is, the commutation of the current, can be done either by breaking or by short-circuiting both the electro-magnet and the main line at the moment of commutation. In the latter case a suitable resistance can be thrown in both circuits.

It does not seem likely that anybody would risk the breaking of the current, just when the electromotive force of self-induction is near its maximum value. But the only possible and practical method, which shall be considered here, seems to be as follows:—

1. To establish the connection between the electro-magnet and the main line at the time T_1, corresponding to an angle φ_1;
2. To short circuit both the electro-magnet and the main line by means of the commutator brushes and through a suitable resistance, at the time T_2, corresponding to an angle φ_2;
3. To take off the short circuit and establish the first connection again, at the time $T + T_1$, corresponding to an angle $180° + \varphi_1$, and so on.

The current, the magnetism, the resulting or current-producing (heating) electromotive force, the counter electromotive force of self-induction, may be represented by the symbols c, m, e, e_i, respectively; their maximum values by the capitals C, M, E, E_i.

Let the magnetic resistance of the electro-magnetic circuit $= \rho$.

Let the number of magnetizing turns $= n$.

Then the coefficient of self-induction $\mathbf{K} = \frac{n^2}{\rho} 10^9$ henry[1].

Let the electric resistance of the magnet circuit $= r\,\Omega$.

Let the electric resistance of the main circuit $= r_0\,\Omega$.

Let the short-circuiting resistance $= R\Omega$;

then the magnetism (number of lines of magnetic force, or, more correctly, tubes of magnetic induction) is:—

$$m = \frac{n\,c}{\rho}; \qquad (2)$$

the induced electromotive force (self-induction):—

$$e_i = -\,n \frac{d\,m}{d\,t} .10^{-8} \text{ volts}; \qquad (3)$$

the resulting electromotive force:—

$$e = e_0 + e_i = E_0 \sin \pi \frac{t}{T} - n \frac{d m}{d t} .10^{-8} \text{ volts}; \qquad (4)$$

and the current:—

$$c = \frac{e}{r + r_0} = \frac{E_0 \sin \pi \frac{t}{T} - n \frac{d\,m}{d\,t} .10^{-8}}{r + r_0} \text{ amperes.} \qquad (5)$$

Combining (2) and (5), we find:—

$$m = \frac{n}{\rho\,(r + r_0)} \left\{ E_0 \sin \pi \frac{t}{T} - n \frac{d\,m}{d\,t}\, 10^{-8} \right\} \qquad (6)$$

as the differential equation of the magnetism during the time from T_1 to T_2.

This differential equation is integrated by the function:—

$$m = A \sin (\pi \frac{t}{T} - \omega) + B\,e^{-\Sigma t} \qquad (7)$$

the constants of which are obtained by substituting the value m of equation (7) in equation (6).

$$\text{Since, } \frac{d\,m}{d\,t} = \frac{\pi}{T} A \cos (\pi \frac{t}{T} - \omega) - \Sigma\,B\,e^{-\Sigma t},$$

we get:—

$$A \sin (\pi \frac{t}{T} - \omega) + B\,e^{-\Sigma t} = \frac{n}{\rho\,(r + r_0)} \left\{ E_0 \sin \pi \frac{t}{T} - \frac{n\,\pi}{T} A \cos (\pi \frac{t}{T} - \omega) .10^{-8} + n\,\Sigma\,B\,e^{-\Sigma t} .10^{-8} \right\}$$

which equation is satisfied for any value of t, when:—

1. I do not think it necessary, in an American journal, to give an explanation for using the term "henry" as the practical unit of self-induction, instead of the "quadrant."

$$\left.\begin{aligned} A\cos\omega &= \frac{n}{\rho(r+r_0)}\cdot\left\{E_0-\frac{n\pi}{T}A\sin\omega\,.10^{-8}\right\};\\ A\sin\omega &= \frac{n}{\rho(r+r_0)}\cdot\frac{n\pi}{T}A\cos\omega\,.10^{-8}\\ B &= \frac{n}{\rho(r+r_0)}\,n\,\Sigma B\,.10^{-8}. \end{aligned}\right\}$$

From this we have :—

$$\left.\begin{aligned} A &= \frac{n\,E_0}{\sqrt{\rho^2(r+r_0)^2+\dfrac{n^4\pi^2}{T^2}.\,10^{-16}}};\\ \tan\omega &= \frac{\pi n^2.10^{-8}}{\rho(r+r_0)\,T};\\ \Sigma &= \frac{\rho(r+r_0)\,.10^{-8}}{n^2}=\frac{\pi}{T}\cos\omega; \end{aligned}\right\} \quad (8)$$

B being still unknown.

From this, we get the magnetism at the time T_1 :—

$$M_1 = A\sin(\varphi_1-\omega)+B\,e^{-\Sigma T_1} \quad (9)$$

and at the time T_2 :—

$$M_2 = A\sin(\varphi_2-\omega)+B\,e^{-\Sigma T_2} \quad (10)$$

A, ω and Σ, being already known,

$$\varphi_1=\pi\frac{T_1}{T}=\frac{T_1}{T}.180^\circ.\quad \varphi_2=\pi\frac{T_2}{T}=\frac{T_2}{T}.180^\circ. \quad (11)$$

During the time of short-circuit, from $t=T_2$, to $t=T+T_1$, the inductional electromotive force is :—

$$e_i^1 = -n\frac{d\,m^1}{d\,t}.10^{-8}\text{ volts}; \quad (12)$$

and the current :—

$$c^1=\frac{e_i^1}{r+R}=-\frac{n}{r+R}\cdot\frac{d\,m^1}{d\,t}.10^{-8}\text{ amperes.} \quad (13)$$

Therefore the magnetism is :—

$$m^1=\frac{n\,c^1}{\rho}=-\frac{n^2}{\rho(r+R)}\cdot\frac{d\,m^1}{d\,t}.10^{-8}; \quad (14)$$

which integrated gives :—

$$m^1 = M_2\,e^{-\Sigma^1(t-T_2)}, \quad (15)$$

where :— $$\Sigma^1=\frac{\rho(r+R)\,.10^{-8}}{n^2}, \quad (16)$$

since for $t=T_2$, m^1 must equal M_2.
Therefore for $t=T+T_1$,

$$m^1 = M_2\,e^{-\Sigma^1(T+T_1-T_2)}. \quad (17)$$

Now, at this moment, the electro-magnet is connected again with the main circuit, and therefore, in stationary condition, the magnetism again equals M_1.

This, together with (9), gives us the equations necessary for determining B :—

$$A\sin(\varphi_1-\omega)+B\,e^{-\Sigma T_1}=$$
$$\left\{A\sin(\varphi_2-\omega)+B\,e^{-\Sigma T_2}\right\}.\,e^{-\Sigma^1(T+T_1-T_2)},$$

from which :

$$B=A\frac{\sin(\varphi_2-\omega)-\sin(\varphi_1-\omega)}{e^{-\Sigma T_1}-e^{-\Sigma T_2-\Sigma^1(T+T_1-T_2)}}. \quad (18)$$

Now, everything being known, we can investigate the behavior of the current.

Between T_1 and T_2, the current is given by equation (2)

$$c=\rho\frac{m}{n};\text{ or,}$$

$$c=\frac{\rho}{n}A\sin\left(\pi\frac{t}{T}-\omega\right)+\frac{\rho}{n}B\,e^{\Sigma t}\text{ amperes.} \quad (19)$$

Between T_2 and $T+T_1$ the current in the electro-magnet is given by equation (12)

$$c^1=\frac{\rho\,m^1}{n};\text{ or,}$$

$$c''=\frac{\rho}{n}M_2\,e^{-\Sigma^1(t-T_2)}\text{ amperes}; \quad (20)$$

and at the same time in the main circuit :

$$c''=\frac{e_0}{r_0+R}=\frac{E_0}{r_0+R}\sin\pi\frac{t}{T}\text{ amperes.} \quad (21)$$

A very interesting conclusion in regard to sparking at the commutator can be drawn from the equations (19) to (21) :

It is obvious, that sparking at the commutator must disappear entirely if the short circuit has no current just at the moment of its breaking; that is, when at the time, $t=T_1$, $c^1=c''$.

This gives the equation :

$$\frac{\rho}{n}M_1=\frac{E_0}{r_0+R}\sin\pi\frac{T_1}{T}. \quad (22)$$

On the other hand, there will be given no cause for disturbances in the main line nor in the electro-magnet circuit, if the short circuit, applied at the time T_2, is without current in the first moment, so that neither the current in the main line, nor in the electro-magnet is affected; that is, when, at the time $t=T_2$, $c^1=c''$.

This gives the equation :

$$\frac{\rho}{n}M_2=\frac{E_0}{r_0+R}\sin\pi\frac{T_2}{T}. \quad (23)$$

These two equations (22) and (23) give us the two moments, T_1 and T_2, between which the commutation of the current has to take place, in order to avoid sparking at the commutator, and extremely rapid changes of the main current, and gives us thereby the width of the commutator-bars and of the gap between adjacent commutator-bars.

I am told that the above mentioned synchronous motor of Ganz & Co. owes its sparkless running to a similar arrangement. Besides this, the average magnetism, and the energy of the current, is much higher in circuits of this kind, as the accompanying diagrams (Figs. 1 and 2) show, which represent some curves of magnetism excited by such pulsating currents.

In Fig. 1,
the number of exciting turns, $n=200$.
" impressed electromotive force : $C_0 = 71$ volts (effective); therefore,
" maximum impressed electromotive force : $E_0=100$ volts.
" electric resistance of the field-magnet circuit: $r=5\,\Omega$
" " " " " main line: $r_0 = 10\ \Omega$.
" " " " " short circuit : $R=0$.
" magnetic resistance of the electro-magnet : $\rho=0.01$.

Therefore, the coefficient of self-induction : $\mathbf{K}=\frac{n^2}{\rho}.10^{-9}=$ 0.004 henry.
the time of half a period : $T=0.005$ second.
" " " connecting the electro-magnet with the main line : $T_1=0.0007$ second.
" time of short circuiting the electro-magnet and the main line : $T_2=0.00415$ second.
Therefore,
$A=68{,}000$.
$\tan\omega=1.676$. Angle $\omega=59^\circ$.
$\Sigma=375$.
$\Sigma^1=125$.
$M_1=\ 84{,}000$ lines of magnetic force.
$M_2=102{,}000$ " " "
$B=163{,}000$.

Therefore :

between T_1 and T_2: $m = 68{,}000 \sin (36{,}000\, t - 59)^\circ + 163{,}000\, e^{-375t}$.

between T_2 and $T + T_1$: $m_1 = 102{,}000\, e^{-195(t-0.00416)} = 171{,}000\, e^{-195t}$.

between T_1 and T_2: $c = 3.4 \sin (36{,}000\, t - 59)^\circ + 8.1\, e^{-375}$ amperes.

between T_2 and $T+T_1$: $c^1 = 8.6\, e^{-195}$ amperes in the electro-magnet,

$c'' = 10 \sin (36{,}000\, t)^\circ$ amperes in the main line.

At the time T_1: $c = c^1 = c'' = 4.2$ amperes.

At the time T_2: $c = c^1 = c'' = 5.1$ amperes.

In the diagram, Fig. 1, c, c^1, c'', and m, m^1 are the curves of the current and of the magnetism respectively; a is the curve, which the current would follow, if there were no self induction at all; b is the curve of the current and of the magnetism, if there were no commutation of the current, but the magnetism would reverse alike in the transformer. As shown in this latter case, the mean magnetism and the mean current is only about one-third of the value of that obtained by commuting the current.

In the moments T_1 and T_2 there is no discontinuity, and the short circuit being currentless, also no cause for sparking.

It will be seen that the magnetism and current follow a slightly undulating line, which would be still more like a straight line if the self-induction were higher.

In the diagram, Fig. 2,

$$r_0 = 5\,\Omega.$$
$$\rho = 0.05.$$
$$\mathbf{K} = \frac{n^2}{\rho}.10^{-9} = 0.0008 \text{ henry.}$$
$$T_1 = 0.001. \qquad T_2 = 0.004.$$

The other values are the same as in diagram, Fig. 1; therefore :

$m = 36{,}000 \sin (36{,}000\, t - 27)^\circ + 12{,}000\, e^{-1350t}$.

$m^1 = 388{,}000\, e^{-625t}$.

$c = 9 \sin (36{,}000\, t - 27)^\circ + 3\, e^{-1250t}$ amperes.

$c^1 = 48.5\, e^{-625t}$ amperes.

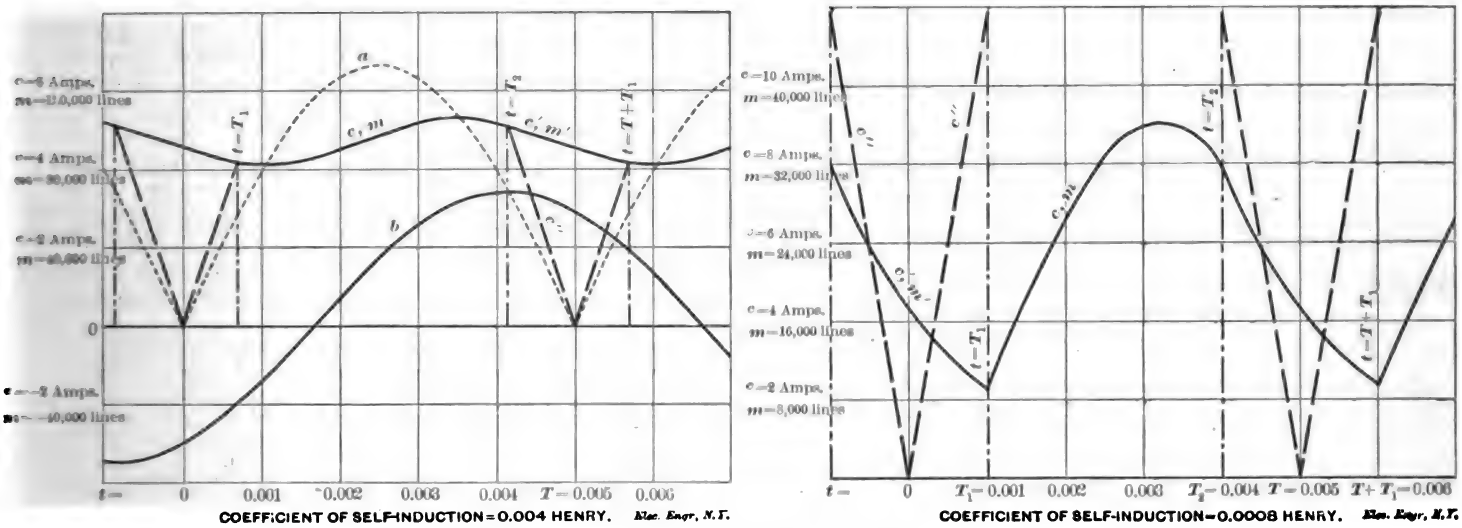
$c'' = 20 \sin (36{,}000\, t)^\circ$ amperes.

At the time T_1: $c = c^1 = 2.3$ amperes; $c'' = 11.8$ amperes.

At the time T_2: $c = c^1 = 8$ amperes; $c'' = 11.8$ amperes.

Here, the self induction being much smaller, the vibrations of current and of magnetism in the electro-magnet are much greater. But the most interesting fact is, that the short-circuiting of the electro-magnet, and the breaking of this short-circuit take place in wrong positions, and in the moment T_2 the main current has to jump from 8 amperes to 11.8 amperes; in the moment T_1 from 11.8 amperes to 2.3 amperes; and because at this moment there flows a current of 11.8—2.3 = 9.5 amperes through the short circuit under the brushes, the breaking of this current will cause an excessive and destructive sparking at the commutator-brushes. Besides this, the curve of the magnetism shows breaks at the points T_1, T_2, $T+T_1$, etc.

The commutator would indeed be improved by throwing a resistance R into the circuits between T_2 and $T+T_1$, but this would not stop sparking entirely.



FIGS. 1 AND 2.—STEINMETZ ON THE RECTIFYING OF ALTERNATING CURRENTS.

SOME DEFECTS IN PHYSICAL TERMINOLOGY.—I.

BY PROF. A. E. DOLBEAR.

THE science of physics is concerned with the conditions of the transference and transformation of energy wherever they occur, and for that reason it is not infrequently called the science of energy. Within the past fifty years a vast amount of attention has been given to the phenomena in different departments of physics; especially is this true of molecular phenomena, and our knowledge of it is really extensive. At the same time there has been a serious lack of coördination among the different departments exhibited in late treatises that form a real hindrance to one who would obtain a fair view of what is really known. Whewell attributes the failure of the Greeks to make headway in physical science, to the fact that their ideas were not appropriate to the phenomena. In a like manner it may be said that we are retarded by the lack of appropriate terminology, and that something will be gained when the terminology is so far reconstructed as to be incapable of misleading one.

First, as to the nature of energy. In Daniell's "Text-book of the Principles of Physics" the statement is made that "energy is a physical entity," implying that it is an independent, objective something, an existence not conditioned by other physical things, and this idea is so common that it is worth while to closely inspect it. Now energy is defined as the ability to do work, and work is measured in foot pounds. When we give expression to the relation between energy and work we have, $\frac{M v^2}{2} = W h$, when M is the mass, v the velocity, W its weight and h the height to which W will be raised. But $\frac{M v^2}{2}$ is the measure of energy in the units of work. In absolute units it is proportional to $M v^2$, or, as it is perhaps better to write it, $M v \times v$, which is the *velocity of momentum.* As there is

no such thing known as energy where there are not two factors, namely, a something—a real entity—and a motion, it follows that when there is absolute quiescence there is no energy, and if there be no substance, though velocity be infinite, there is no energy. Hence energy is a *product* and is not a something that exists apart from moving bodies. It is a product of substance and motion, and is proportional to the amount of motion. No body moves in any manner whatever except as antecedent motion has been spent upon it, and if one would seek for the origin of the motion of any mass of matter he might trace it never so far back only to find an antecedent motion; and on the supposition that the physical universe is infinite in extent then the amount of motion is also infinite, as well as the energy.

There is then no good reason for considering energy as being a mysterious something that has an existence apart from the substance of the physical universe any more than there is for considering the same for motion or for momentum.

Second. It appears that the so-called *forms of energy* depend upon the form of the motion involved as well as the character of that which is moved. As to the first of these, the kinds of motion, that are possible, are probably very great in number, but they may all be reduced to their primary forms, namely rectilinear, vibratory and rotary. Combinations of these yield all sorts of others. For instance, two rectilinear will give either a resultant rectilinear, as exhibited in the so-called parallelogram of forces, or a curvilinear, as in the movement of a bullet fired from a gun in other than a vertical direction. A combination of a rectilinear with a vibratory gives an undulatory or wave motion; a rectilinear with a rotary gives a spiral, and so on.

The expression for the energy of a body is not limited by the size of the body. It is as applicable to an atom as to a cannon ball or the earth in its orbit, but it is convenient to change the form of it where the physical conditions warrant it. For rectilinear motions or combinations of them the form $\frac{Mv^2}{2}$ is used for both large and small bodies, only such motions of atoms and molecules are called free paths, or the distance between successive impacts. It is not inappropriate to speak of the motions of larger bodies, as for instance that of a musket bullet towards a target, as its free path. In either case v is simply the rate of motion.

For vibratory motion, however, the value of v depends upon two conditions, the number of vibrations per second, n, and the amplitude of the vibration, a. These are entirely independent of each other, and either may have almost any assigned value, so that $v = a\,n$, and the energy is $\frac{M a^2 n^2}{2}$.

For a rotating particle, energy $= \frac{M r^2 \omega^2}{2}$, where r is the distance to the centre of rotation and ω is the number of degrees passed over in one second. It may have substituted for it the expression for rectilinear energy by making v the number of feet passed over in a second.

When the moving body is so large that its motions may be seen, the body is said to have *mechanical* motion or mechanical energy, sometimes kinetic energy, and when the body is too small to be seen the movements are spoken of as atomic or molecular; and here is where trouble often begins, by failing to keep in mind that the size of a body makes no difference in the character of the motions it may have.

Suppose a bell or tuning fork, or any elastic body, be suspended in the middle of the room, and it be struck by a body in any convenient way, vibrating motions will result that we should interpret as sound, and at the same time a free path motion would be set up, which would be restrained by the support so as to become oscillatory if it be no longer interfered with. Precisely similar conditions obtain when an atom or a molecule of air or other gas is made to vibrate by impact. It vibrates at its own harmonic rate and also moves in a free path till a collision occurs which changes its direction in its free path and interferes with its internal vibration. The swinging tuning fork gives out its proper sound, but we never think of speaking of its free path motion as a part of its sound motion. Whether it swings or not, is quite immaterial. Of course if it swings while it vibrates it possesses more energy than if it vibrated only, but the energy could not be spoken of as sound energy. No more should the free path movements of molecules, be they long or short, be called heat motion. This needs a little fuller development.

For twenty-five years or more we have been familiar with the expression, "*Heat is a mode of motion*," and lately we have it in numerous works intended to be exact that "*Heat is a form of energy*." To illustrate the fogginess upon this matter, I cannot do better than to quote statements from several text books lately issued. In Daniell's "Principles of Physics," p. 325, there is the definite statement in large print, "*Heat is a form of energy*." On p. 326 is this statement, "Heat is not motion;" and on p. 444, "The molecular vibration which excites ether waves is a true vibration of the molecule, not a transtational oscillation from place to place." Olmstead's "College Philosophy" (Kimball's revision) has it, "There is abundant reason for believing that heat consists of exceedingly rapid vibrations of ordinary matter and of the ether which fills all space." In Avery's "Elements," "Heat is a form of energy. It consists of vibratory motions of the molecules of matter." In "National Philosophy," by Sharpless and Phillips, "Heat like light, consists of waves of ether." In Gage's "Elements of Physics," "Heat is molecular motion." In "The New Physics," by Trowbridge, there is the statement that "motion is therefore being continually changed into heat in all the operations of machines." Also, "The phenomena of heat and light are so closely allied that it is impossible to regard them as separate manifestations of energy."

Maxwell says: "Heat is of the same nature as mechanical work, that is, it is one of the forms of energy." Also, "We have no right to speak of this process of radiation as heat," and again, "Heat can be generated and it can also be destroyed." "For every foot-pound of work so done, a certain quantity of heat is put out of existence."

These quotations are quite sufficient to show that there is no agreement among authors as to what the nature of heat is, nor is there always consistency in the treatment by a given author. There are the contradictory statements that heat is a mode of motion, and that it is not motion,—that it is energy, and that it can be destroyed; that it is ether waves and that ether waves cannot properly be called heat.

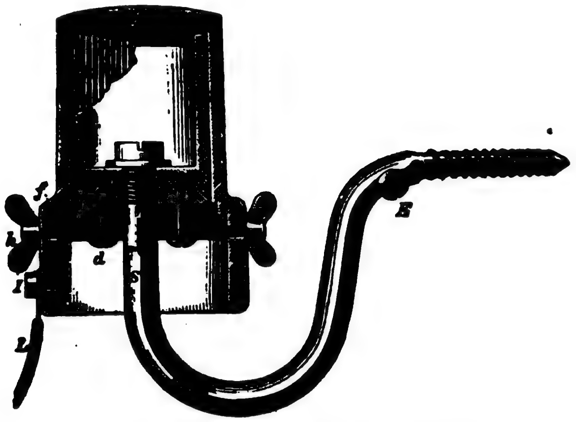
MULTIPLEX TELEPHONY.

The attempts which have in the past been made to multiplex telephone lines have mostly been based on the differential method of working. When, some time ago, Lieut. F. Jarvis Patten designed his system of multiplex telegraphy, however, he also recognized the applicability of the system to telephony, but his attention was so much occupied by the telegraph that the former was laid aside temporarily. Recently, however, he has taken up the telephone again, and has now succeeded in operating a good sextuplex, by which six telephone messages can be sent simultaneously over a single line with either grounded or metallic circuit. The further development of the system will be watched with great interest.

THOMSON ELECTRIC WELDING COMPANY.—The American Wheel Co., headquarters at Chicago, which has bought up all the principal wheel companies of the United States, has heretofore sold its wheels without tires, but will hereafter tire all wheels before sending them out, using the electric welding process. This will bring the Thomson Electric Welding Co. a revenue from royalties on at least 1,000,000 welds annually.

THE WEHR LIGHTNING ARRESTER.

The custom has prevailed almost universally hitherto of mounting lightning arresters in close proximity to the apparatus to be protected within buildings, thus allowing the lightning charge to pass into the building before it is turned aside to be discharged into the earth. It is evident, however, that increased safety may be attained if lightning arresters, even for ordinary apparatus, can be placed entirely without the building. When thus placed, however, it is evident that it must be so designed as to be protected against the influences of the weather and malicious interference. With the object of affording lightning protection to instruments while confining the path of the current to the outside of the building, Mr. G. Wehr, of Berlin, has designed a lightning arrester, known as the "Universal," which is illustrated in the accompanying engraving. The instrument is there shown as designed for the protection of but a single conductor, and consists of a bell-shaped hood *g*, of galvanized cast-iron, which is connected with the earth. The upper, interior part of this bell is provided



The Wehr Lightning Arrester.

with vertical ribs. The lightning arrester, *a*, is supported by the bent rod s, provided with a wood or steel screw. The arrester *a*, it will be noted, is cone-shaped, and made of brass, with small horizontal ribs. The cone is in metallic connection with the support s, which is connected to earth by means of the screw E. Both parts are insulated from the hood *g* by the ebonite plates *b* and *c*. Resting on the heel of the lower ebonite plate *c* is a soft rubber ring, *f*, which, being compressed by the hood, makes an air-tight joint between the hood and the arrester *a*. The presence of this rubber washer prevents the entrance of dust and metallic particles as well as dampness between the conductor and the earth connection. The thumb-screws *h* serve to fasten the hood *g* to the plate *c*, maintaining the cone *a* on the ebonite piece. In the arresters of this pattern, designed for 2, 3 and 4 conductors, the interior cone is divided vertically into as many parts as there are conductors to be protected. Each of these parts is connected with a short column provided with a screw to which the conductors to be protected are connected.

AN ELECTRIC RIVETING MACHINE.[1]

Electricity has already been applied in a variety of ways to the driving of tools and iron-working machinery, and its most recent application is to a riveter designed by M. Singre. This machine is based on the same principle as the coin presses now in general vogue, and in which the principle employed is to give a large mass a considerable energy which is suddenly deprived of that energy by the die coming in contact with the metal which receives the impression. The accompanying illustrations represent the new machine, Fig. 1 being a horizontal section of the electric motor, which has four poles, A being the ring, B the field magnet coils and C the pole pieces. Fig. 2 represents a vertical section.

As will be seen, the axis or shaft of the ring armature consists of a screw-threaded tube maintained in its position

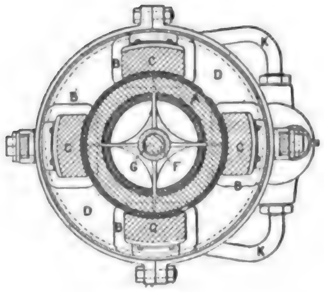


Fig. 1.—The Singre Electric Riveter.

at its upper end by the cap, H, and below by means of a collar. The commutator is shown at E. In the interior of the screw-threaded tube there is situated a very heavy screw, F, which does not rotate with the ring, being held in a fixed position by means of the guides shown in Fig. 3. The screw is terminated by a piston, J, which penetrates a reservoir of oil, J, from which lead two tubes, K K. These tubes end in a cylinder in which there moves a piston of large surface, L. The end of this piston carries the die, M, which forms the rivet-head, the opposite, abutting die, N, being placed at the lower end.

When the current is sent through the motor the latter at

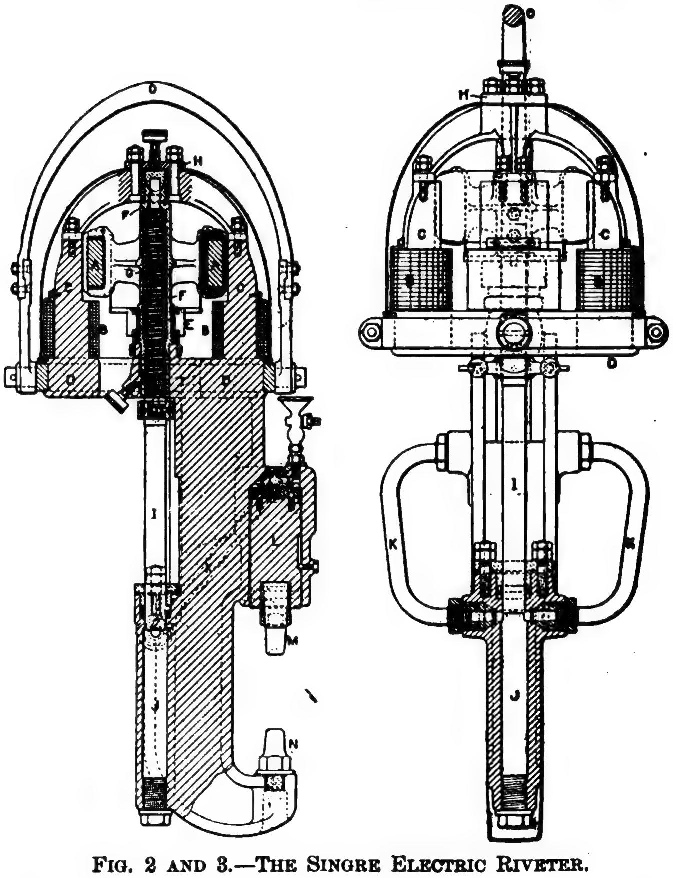


Fig. 2 and 3.—The Singre Electric Riveter.

once attains a very high speed which increases, owing to the fact that there is scarcely any resistance to overcome, and hence the piston, I, descends very freely at a considerable velocity; but at the moment the die, M, meets the rivet head it is suddenly stopped; but the ring, the core of which is of iron, and very heavy, has acquired considerable energy during the free descent of piston, I. On the other hand the combination of a screw and hydraulic press makes a powerful combination, which lends itself readily to the exertion of great power with a small initial force.

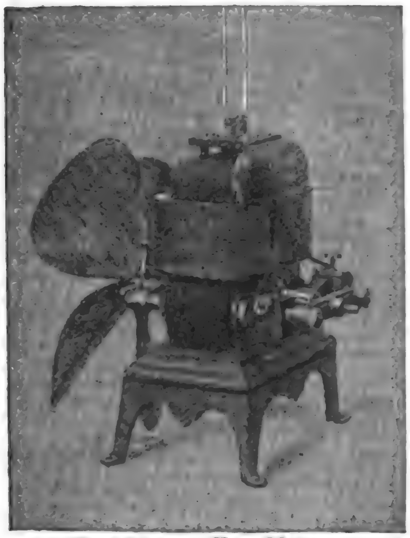
1. M. Deprez in *La Lumière Electrique*.

ELECTRIC FANS FOR HOT WEATHER.

THE recent hot weather has naturally directed the attention of the public to artificial methods of cooling, and it may safely be said that of such methods one of the most popular to-day is that of propelling small fans by electric motors. A few years ago, and even to-day, mechanical or clock-work fans were in general favor, but their size, and awkwardness of motion, as well as the feebleness of the breeze created by them, has prevented such a universal adoption of them, as now awaits the electric fan.

Some of the electric motor companies have considered the fan business as beneath their dignity, and they have therefore refrained from making "fly-power" motors. In this respect, they have, we think, made a mistake, even though the field is large enough to occupy their attention in other directions. In the aggregate the small motors represent a large sum of money and a large amount of power, and each is, or should be, an excellent advertisement for its builder. In a few years there will certainly be as many such motors as there are sewing machines, for example, and the number will be even greater when the opportunities for their use in driving fans, sewing machines, dental lathes, phonographs, graphophones and other minor appliances of comfort and civilization are appreciated.

Among those who have from the first exploited the small, as well as the large, motor field are the Elektron Manufacturing Company, of Brooklyn, whose fan motor we illustrate on this page. A large number of these have been



THE PERRET FAN MOTOR.

put in service all over the country, and in Brooklyn these Perret motors have literally become a "household word," so universally have they been introduced throughout that city of homes. The cut represents a Perret motor (type A. O. single speed) with a four-bladed fan on the armature shaft. The same fan fits the three speed motor, and the latter is used when change in strength of the breeze is desired. The motor may be screwed to a shelf in such a manner that the fan will clear its edge, but a better arrangement is that shown in the figure, where the motor is fixed on a neat japanned iron stand, which permits it to be set on any flat top table. A wire guard which is easily attached to the motor and which surrounds the fan, preventing accidental contact with the revolving blades, may be used if desired.

A suitable 2 volt primary cell, such as the Mason or other of that type, in connection with this apparatus will produce a gentle breeze, at a cost of about one cent per hour, and two cells will give a blast twice as strong, which is as much as would ever be required in an ordinary sized room. Current required is from 3 to 5 amperes. A similar result will be produced by one or two storage cells.

The operation is smooth and quiet and the motor is ornamental as well as useful, especially when nickel-plated. It deserves note that in these small motors, the same distinctive features of lamination of the field magnets are adhered to. The weight of the one-eighth horse-power motor here shown is only 13 lbs. It is run with a round eighth-inch belt on a $1\frac{1}{4}$ inch pulley, the speed depending, of course, upon the current supplied.

ELECTRO METALLURGY.

MESSRS. SIEMENS AND HALSKE, of Berlin, have recently patented a process for the electrical treatment of ores, of which the following are the principal points: The ore, first being pulverized, is put into a cylinder filled with a solution of sulphate of iron. The mixture is kept constantly in motion by means of moving pallets, and if there is need the bath is steam-heated. If the process is used for amalgamation, cylinders of copper, partly plunged in mercury, are placed in vessels and set in a rotatory motion. This movement assures a constant contact between them and the mineral, and the reduction takes place. In a more general case a solution of alkaline cyanide is added to the electrolyte, and an electric current is turned on. The metal is deposited on a cylinder of copper. After the operation the copper is recovered by ordinary methods. This process will be applicable in the treatment of the ores of copper, zinc, and precious metals.

MEASUREMENT OF ELECTRO-MAGNETIC RADIATION.

At a meeting of the Physical Society the results of an important research on the measurement of electro-magnetic radiation were experimentally shown by Mr. Vernon Boys. It will be remembered that Mr. Gregory some time since succeeded in measuring the expansion of a fine wire caused by the heating effect of the electrical oscillations set up within it; and, with the view of confirming this result, Mr. Boys has employed two distinct methods, the application of which has needed great ingenuity and manipulative skill. One of these methods, depending on the mechanical forces exerted between two adjacent wires in which oscillations were induced, appeared at first to succeed, owing to an extraneous effect; but after this had been carefully eliminated, no action could be detected, although the adjustments were delicate enough to indicate a force of less than a one hundred-millionth part of a grain.

JERRITT'S MILITARY FIELD SOUNDER.

This apparatus, which has been devised by Mr. Jerritt, of Plymouth, England, consists of a small instrument so arranged as to be capable of being used as a transmitter and receiver. By an ingenious arrangement, the lever of the sounder is employed both for sending and receiving messages, thus doing away with the ordinary apparatus for transmitting telegraph work, the current being put on and off by means of a small switch fixed to the base of the instrument. A telephonic arrangement can be adjusted for receiving purposes if required. The instrument, battery, sounding-box, and telescopic stand fold up and form a compact knapsack, and can be comfortably carried as such by any operator. The centre of the stand, it may be mentioned, can be used if necessary as a drum for winding a quantity of wire.

ELECTRO-MAGNETIC REPULSION.

Those who have not the means of showing the striking effects produced by Prof. Elihu Thomson, writes Mr. W. B. Craft, in *Nature*, may be glad to know a simple illustration of the same principle.

A top consists of a soft iron disc with a brass axis put through it. A small magnet is held over the edge whilst spinning; each elementary sector as it moves up to and away from the poles of the magnet has currents induced which are repelled by the magnet; as the rotation dies out, the currents at a certain point become too feeble to overcome the attraction of the soft iron by the magnet.

SAN FRANCISCO WIRE-TAPPERS CAUGHT.

After faithful watching and waiting for the last eighteen months the Detective Department of San Francisco caught recently two of a band of thieves who have robbed the pool-rooms of San Francisco of nearly \$100,000. The prisoners are a telegraph operator and a young man about town whose father left a considerable sum to his boy by will about two years ago. The men were captured in the Benson Building while in the act of receiving a message over a looped-wire. They had connected their wires with those leading to the pool-rooms.

INSURANCE OF ELECTRIC PLANTS.

NOTHING for a long time has created quite so much stir and excitement with the stock fire insurance companies and their local agents as the advent of the Electric Mutual Insurance Company to insure electric plants.

Ever since the first plant was established, these companies and agents have looked upon the risks as being very hazardous, and for the most part the companies have declined to insure them; not because there is any record to show by their having burned frequently that they were extra hazardous, but the same old "mysterious something" (and they knew not what) has made their judgment hide behind their fear. Of course, the agent has sought high and low for companies that would take the risks so that he might secure his 15 or 20 per cent. commission on the premiums. The hazard of the risk was nothing to him if he could "place" it at all; in fact, the supposed extra hazardousness has operated to his great advantage, because the greater the premiums the more commission he realized.

Several companies, being willing to gamble on anything at a high rate, have all along accepted the risks, but by reason of there being but few taken they have been enabled to secure very exorbitant rates. They have cried down the risks and raised their rates, but they haven't refused any of the business, except to get a higher rate. As a result they have made large profits. The rates have been made so high that few of the electric companies have felt able to carry more than a very small percentage of their value in insurance. As a consequence, when a small loss would occur it would result in nearly a total loss to the insurance companies under their policies. Then would go up the cry that not only were electric stations *very extra hazardous*, but the property was *very perishable*, and a small fire that wouldn't damage any other kind of machinery very much would *ruin* dynamos and other electric apparatus. So that early in the game they began to discriminate against dynamos, and to apply the "co-insurance clause" to their policies. The latter clause is one which compels the property owner to have full insurance or become a contributor to his own loss, in the proportion that his insurance is less than the value of his property.

The condition of things has been growing worse rather than better. In many parts of the country electric stations have been tariff-rated by the insurance boards at figures ranging from 2 to 4 per cent.—almost as high as planing mills and other similar risks. The result of this rating has been to debar all "board" companies from taking the risks at less rates even if they were willing to do so. Another result of the tariff and of the small number of responsible companies that would accept such risks has been the compelling of agents to secure policies in all sorts of shyster or irresponsible companies, because the high rates (presumed to have been made intelligently) have frightened the good companies to that degree that a sufficient number could not be found to carry the amount of insurance wanted. The agent's only recourse then was to get policies where he could and at such rates as he could. If the names of companies carrying electric station risks at the present time could be made public it would probably disclose the poorest lot of companies, as a class, on any risk in the market; and, if the rates could also be made public, it would indicate the highest rated risk as a class. Under such circumstances it is not strange that the electrical interests should welcome the advent of a company of their own, allied to no tariff organization and therefore free to act independently and intelligently, as well as being governed by a board of directors, all of whom are electrical men. But how changed and varied is the attitude of the several underwriters' boards! In some instances they get their heads together and say: "We will maintain our tariff rates on each station until we feel that the Electric Mutual Company is after it and then we will drop our rates sufficiently to hold the risk." In other cases they conceive the idea that the Mutual Company can only carry a small portion of the risk anyway, and that if they can, through board obligations, prevent stock companies from co-operating with the Mutual, it will be unable to control the rates on the whole risk, and thereby they can retain a part of it at their own high figures, besides having the guarantee of an improved risk through the inspection of the Mutual, without cost to themselves.

Several of the largest stock companies doing business in the country realized in the beginning the advantage of taking surplus insurance from the Electric Mutual Company and entered into an arrangement with that company whereby they were to accept all risks offered and at rates named by the Mutual, and they were to pay their share of the expense of examinations. No sooner, however, had they secured a few risks in this way than the local agent (who had lost the risk and thereby his big commission) began to pour his complaints into his companies that his inalienable (?) rights were being violated by "Board" companies—that he was being deprived of good business that he could hold at high rates (and big commission) if the Board Companies would all stand by him and forsake the Mutual. The complaint was taken up by the "special agent" (the drummer of insurance), who is always eager to enhance the interests of his own company by catering to the feelings of his agent and crying out against the actions of other companies. The local board as a body made its solemn protest, and the cry passed all along the line that "rates were being cut by Board Companies." It came to the great "head centres"—the large organizations composed of the companies, namely:—the "Western Union," the "Middle States Department" and the "South Eastern Tariff Association." Their inquiry went forth, in solemn but determined order, to the companies who were quoted as co-operating with this Mutual—who were aiding and abetting it in its *nefarious* purpose of reducing and equalizing rates. The inquiry was somewhat after the following style:—"You are quoted as having issued your policy on the Electric Light Station, at ...., at 1%, the risk having recently been rated at 3½% by this Association. Will you please advise us if the charge is true; also whether it is your purpose to sustain the rates of this Association, or not?" At the same time the busy and ever-present special agent would put in his work again, with the local agent, by pointing out in his most vivid style the iniquity of the company that would issue a policy through the agency of a competing Mutual Company, in the territory and over the head of their local agent. He would supplement this portrayal of wickedness by advising the agent to give his business only to those companies that would protect him and his rates. And so the offending company would receive its notice from that quarter, either to the effect that its agency was no longer wanted, or by a suspension of business which was tantamount to a notice to the same effect. Nor did it stop there. The special agent and the injured local agent had so poisoned the minds of other local agents that the wicked company, if it sought a representative at another office, found the door locked against it. It seems to be an unfortunate condition of the business that the great insurance company, with its millions of dollars, is forced to make choice between two positions, either abandon its judgment and opportunities as to a certain class of desirable business at fair rates—the electric stations —or suffer the loss of its other good business. Furthermore, it seems that the "special agent" whose Company don't insure electric stations anyway, is the loudest in his howling. He doesn't want the risk and he isn't willing his associate shall have it, because by inveighing against him he can ingratiate himself and his own Company deeper into the heart of the local agent and secure the accompanying favors. It is the same old story of local board and local agent control. It has built up the system of Factory Mutuals in New England which are insuring over $500,000,000 on the best manufactories in the country; and they are doing it at so small a cost that a number of the large stock companies, feeling sore over their past loss of this immense amount of insurance and their continued losses, have recently formed a pool or syndicate to work independently of local boards and agents (doing the self same thing that is complained of in the electrical case), and are offering to take these risks at one-quarter of one per cent. per annum. It costs the manufacturers less to insure with the Mutuals and they will probably stay there.

A number of the Factory Mutuals have insured electric plants for several years and have only met with one loss. They now come forward, it is stated, and offer their co-operation with the Electric Mutual.

After the local agents, with their big rates and big commissions have driven the electric station insurance into Mutuals, it will dawn upon the stock companies that such risks belong in the "preferred class" and their efforts to regain them will probably be equalled only by their action in driving them away now.

In the midst of the tempest that is raging in the insurance teapot it is refreshing to see such sensible words as the following from the *Insurance Times*, of New York, in a recent issue:—"In the West there is the sign of a big row over the insurance of electric lighting plants by the new Electric Mutual Company, of Boston. A plaintive cry is heard all the way from Colorado that local agents have lost a large line on a station in that State because the insurance has been handed over to the Boston concern. One company in this city has a four-page letter from a Colorado special on this topic, and he wants to know what the companies in New York are going to do to protect their Colorado agents. The probable answer is 'nothing,' because in a large majority of such cases the stock of the electric light company is owned in the East, and the owners take out their insurance here for other reasons than to deprive local agents of it. There are a score of corporations with headquarters in Boston, New York and Philadelphia whose properties in the South and West are insured by companies in the cities named for local reasons which to the owners are quite as potential as the claims of local agents to the business."

Some large whiskey risks in Cincinnati were recently transferred from the agents of that place to agents in Peoria, Ill., presumably for reasons satisfactory to the owners of the property. The Cincinnati agents, who seem to think they own the whiskey as well as that part of the earth on which the city stands and considerable country adjacent thereto, got together and, after "whereasing" at great length, they resolved as follows:—

"That we, the undersigned agents, representing the companies set opposite our names, hereby agree that if any companies represented in Cincinnati by authorized agents shall write policies of insurance upon any risk in the territory belonging to said agent

or agents, or having written such policies shall refuse to cancel the same within ten days from date, we, each and every one of us, agree that we shall immediately cease to do any business for such company, and will hold the agency supplies subject to the company's orders; and we, each and every one of us, further agree that we will not accept the agency of any company which desires to change its local agents on account of the enforcement of this compact agreement."

Precisely the same disposition is manifested in relation to the insurance of electric plants in stock companies through any agent who doesn't happen to live next door to the plant. While such arbitrariness exists it is not much wonder that legislatures enact laws adverse to the interests of insurance companies.

ELECTRO-MAGNETIC RADIATION.[1]

In order to discover whether actions are propagated in time or instantaneously, we may employ the principle of interference to measure the wave-length of a periodic disturbance, and determine whether it is finite or no. This is the principle employed by Hertz to prove experimentally Maxwell's theory as to the rate of propagation of electro-magnetic waves. In order to confine the experiments within reasonable limits we require short waves, of a few metres' length at most. As the highest audible note gives waves of five or six miles long, and our eyes are sensitive only to unmanageably short waves, it is necessary to generate and observe waves whose frequency is intermediate between them, of some hundred million vibrations per second or so. For this purpose we may use a pair of conducting surfaces connected by a shorter or longer wire, in which is interposed a spark-gap of some few millimetres' length. When the conductors are charged by a coil or electrical machine to a sufficiently high difference of potential for a spark to be formed between them, they discharge in a series of oscillations, whose period for systems of similar shape is inversely proportional to the linear dimensions of the system so long as the surrounding medium is unaltered. When the surrounding non-conducting medium changes, the period depends on the electric and magnetic specific inductive capacities of this medium. Two such systems were shown: a large one, whose frequency was about 60 millions per second; and a small one, whose frequency was about 500 millions per second. The large one consisted of two flat plates, about 30 cm. square and 60 cm. apart, and arranged in the same way as is described by Prof. Hertz in *Wiedemann's Annalen*, April, 1888. The smaller vibrating system consisted of two short brass cylinders terminating in gilt brass balls of the same size, and arranged in the same way as the smaller system described by Prof. Hertz in *Wiedemann's Annalen*, March, 1889. This latter system was placed in the focal line of a cylindrical parabolic mirror of thin zinc plate, such as that described by Prof. Hertz in this paper.

These generators of electro-magnetic oscillations may be called electric oscillators, as the electric charge oscillates from end to end. A circle of wire, or a coil in which an alternating current ran, or, if such a thing were attainable, a magnet alternating in polarity, might be called a magnetic oscillator. A ring magnet with a closed magnetic circuit is essentially an electric oscillator, while a ring of ring magnets would be essentially a magnetic oscillator again. The elementary theory of a magnetic oscillator can be derived from that of an electric oscillator by simply interchanging electric and magnetic force. Electricity and magnetism would be essentially interchangeable if such a thing existed as magnetic conduction. The only magnetic currents we know are magnetic displacement currents and convection currents, such as are used in unipolar and some other dynamos. It is in this difference that we must look for the difference between electricity and magnetism.

In order to observe the existence of these electro-magnetic oscillations we can employ the principle of resonance to generate oscillations in a system whose free period of oscillation is the same. A magnetic receiver may be employed, consisting of a single incomplete circle of wire broken by a very minute spark-gap, across which a spark leaps when the oscillations in the wire become sufficiently intense. In order that a large audience may observe the occurrence of sparks, the terminals of a galvanometer circuit were connected, one with one side of the spark-gap, and the other with a fine point which could be approached very close to the other side of the spark-gap. It was observed that, when a spark occurred in the gap, a spark could also be arranged to occur into the galvanometer circuit, and, with a delicate long-coil galvanometer (that used had 40,000 ohms resistance), a very marked deflection can be produced whenever a spark occurs. This arrangement we have only succeeded in working comparatively close to the generator, because the delicacy required in adjusting the two spark-gaps is so great. It can, however, be employed to show that the sparks produced in this magnetic resonant circuit are due to resonance by removing this receiver from the generator to such a distance that sparks only just occur, and then substituting for the single circuit a double circuit, which, except for resonance, should have a greater action than the single one, but which stops the sparking altogether. An electric receiver was also used, which was identical with the generator, and had a corresponding, only much smaller, spark-gap between the two plates. When the plates are connected with the terminals of the galvanometer, upon the occurrence of each spark the galvanometer is deflected. It is not so easy to obtain sparks when the plates are connected with the galvanometer as when they are insulated, and it is this that has limited the use of this method of observation. By making the first metre or so of the wires to the galvanometer of extremely fine wire, so as to reduce their capacity, we have found that the difficulty of getting sparks is less than with thick wires. We have not observed any effect due to the thickness of the wires after a short distance from the receiver.

In the case of the small oscillator, a receiver exactly like the one described by Prof. Hertz in his second paper, already quoted, was placed in the focal line of a cylindrical parabolic mirror, and its receiving wires were connected with the wires leading to the galvanometer by some very fine brass wire. With the large-sized generator and receiver, which were placed about three metres apart, it was shown that the sparking was stopped by placing a thin zinc sheet so as to reflect the radiations from a point close behind the receiver. By means of a long india-rubber tube hung from the ceiling, it was shown how, when waves are propagated to a point whence they are reflected, the direct and reflected waves interfering produce a system of loops and nodes, with a node at the reflecting point. It was explained that these nodes, though places of zero displacement, were places of maximum rotation, and that the axis of rotation was at right angles to the direction of displacement. It was explained that an analogous state of affairs existed in the electro-magnetic vibrations. If the electric force be taken as analogous to the displacement of the rope, the magnetic may be taken as analogous to its rotation, and the two are at right angles to one another. In the ether the electric node is a magnetic loop, and *vice versa*. Though the two are separated in loops and nodes, they exist simultaneously in a simple wave propagation, just as in a rope when propagating waves in one direction the crest of maximum displacement is also that of maximum rotation. It was explained that by placing the reflector at a quarter of a wave-length from the receiver this would be at an electric loop, and have its sparking increased. It may thus be shown that there are a series of loops and nodes produced by reflection of these electro-magnetic forces, like those produced in any other case of reflected wave-propagation. This was Hertz's fundamental experiment, by which he proved that electro-magnetic actions are propagated in time, and by some approximate calculations he verified Maxwell's theory that the rate of propagation is the same as that of light. It follows that the luminiferous ether is experimentally shown to be the medium to which electric and magnetic actions are due, and that the electro-magnetic waves we have been studying are really only very long light waves.

A rather interesting deduction from Maxwell's theory is that light incident on any body that absorbs or reflects it should press upon it and tend to move it away from the source of light. Illustrating this, an experiment was shown with an alternating current passing through an electro-magnet, in front of which a good conducting plate of silver was suspended. When the alternating current was turned on the silver was repelled. It was explained that as the silver could only be affected by what was going on in its own neighborhood, and that if sufficiently powerful radiations from a distant source were falling on the silver, it would be acted on by alternating magnetic forces, this experiment was in effect an experiment on the repulsion of light, which was too small to have been yet observed, even in the case of concentrated sunshine. These slow vibrations are not stopped by a sheet of zinc, though much reduced by a magnetic sheet like tin-plate, though the rapid ones are quite stopped by ether—thus showing that wave-propagation in a conductor is of the nature of a diffusion.

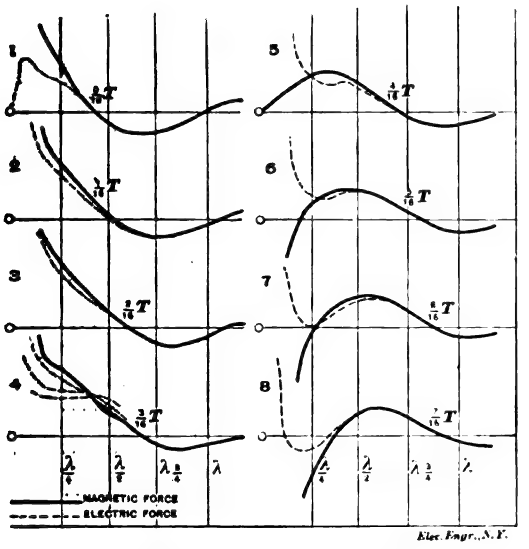
In all cases of diffusion where we consider the limits of the problem, terms involving the momentum of the parts of the body must be introduced. It appears from elementary theories of diffusion as if it were propagated instantaneously, but no action can be propagated from molecule to molecule, in air, for instance, faster than the molecules move, *i. e.*, at a rate comparable with that of sound. In electro-magnetic theory corresponding terms come in by introducing displacement currents in conductors, and it seems impossible but that some such terms should be introduced, as otherwise electro-magnetic action would be propagated instantaneously in conductors. The propagation of light through electrolytes, and the too great transparency of gold leaf, point in the same direction.

The constitution of these waves was then considered, and it was explained that if magnetic forces are analogous to the rotation of the elements of a wave, then an ordinary solid cannot be analogous to the ether because the latter may have a constant magnetic force existing in it for any length of time, while an elastic solid cannot have continuous rotation of its elements in one direction existing within it. The most satisfactory model, with properties quite analogous to those of the ether, is one consisting of wheels geared with elastic bands. The wheels can rotate con-

1. Friday Evening Lecture delivered at the Royal Institution, on March 21, by Prof. G. F. Fitzgerald, F. R. S.

tinuously in one direction, and their rotation is the analogue of magnetic force. The elastic bands are stretched by a difference of rotation of the wheels, and introduce stresses quite analogous to electric forces. By making the elastic bands of lines of governor balls, the whole model may have only kinetic energy, and so represent a fundamental theory. Such a model can represent media differing in electric and magnetic inductive capacity. If the elasticity of the bands be less in one region than another, such a region represents a body of higher electric inductive capacity, and waves would be propagated more slowly in it. A region in which the masses of the wheels was large would be one of high magnetic inductive capacity. A region where the bands slipped would be a conducting region. Such a model, unlike most others proposed, illustrates both electric and magnetic forces and their inter-relations, and consequently light propagation.

In the neighborhood of an electric generator the general distribution of the electric and magnetic forces is easily seen. The electric lines of force must lie in planes passing through the axis of the generator, while the lines of magnetic force lie in circles round this axis and perpendicular to the lines of electric force. It is thus evident that the wave is, at least originally, polarized. To show this, the small-sized oscillators with parabolic mirrors were used, and a light square frame, on which wires parallel to one direction were strung, was interposed between the mirrors. It was shown that such a system of wires was opaque to the radiation when the wires were parallel to the electric force, but was quite transparent when the frame was turned so that the wires were parallel to the magnetic force. It behaved just like a tourmaline to polarized light. It is of great interest to verify experimentally Maxwell's theory that the plane of polarization of light is the plane of the magnetic force. This has been done by Mr. Trouton, who has shown that these radiations are not reflected at the polarizing angle by the surface of a non-conductor, when the plane of the magnetic force in the incident vibration is perpendicular to the plane of incidence, but the radiations are reflected at all angles of



Electro-Magnetic Radiation.

incidence when the plane of the magnetic force coincides with the plane of incidence. Thus the long-standing dispute as to the direction of vibration of light in a polarized ray has been at last experimentally determined. The electric and magnetic forces are not simultaneous near the oscillator. The electric force is greatest when the electrification is greatest, and the magnetic force when the current is greatest, which occurs when the electrification is zero; thus the two, when near the oscillator, differ in phase by a quarter of a period. In the waves, as existing far from the oscillator, they are always in the same phase. It is interesting to see how one gains on the other. It may be worth observing again that though what follows deals with electric oscillators, the theory of magnetic oscillators is just the same, only that the distribution of magnetic and electric forces must be interchanged. Diagrams drawn from Hertz's figures published in *Wiedemann's Annalen* for January, 1889, and in *Nature*, vol. xxxix, p. 451, and in the *Philosophical Magazine* for March, 1890, were thrown on the screen in succession, and it was pointed out how the electric wave, which might be likened to a diverging whirl ring, was generated, not at the oscillator, but at a point about a quarter of a wave-length on each side of the oscillator, while it was explained that the magnetic force wave starts from the oscillator. It thus appears how one gains the quarter-period on the other. The outflow of the waves was exhibited by causing the images to succeed one another rapidly by means of a zoëtrope, in which all the light is used and the succession of images formed by having a separate lens for each picture and rotating the beam of light so as to illuminate the pictures in rapid succession.

As the direction of flow of energy in an electro-magnetic field depends on the directions of electric and magnetic force, being reversed when either of these is reversed, it follows that in the neighborhood of the oscillator the energy of the field alternates between the electric and magnetic forms, and that it is only the energy beyond about a quarter of the wave-length from the oscillator which is wholly radiated away during each vibration. It follows that in ordinary electro-magnetic alternating currents at from 100 to 200 alternations per second, it is only the energy which is some 3,000 miles away which is lost. If an electro-magnetic wave, having magnetic force comparable to that near an ordinary electro-magnet, were producible, the power of the radiation would be stupendous. If we consider the possible radiating power of an atom by calculating it upon the hypothesis that the atomic charge oscillates across the diameter of the atom, we find that it may be millions of millions of times as great as Prof. Wiedemann has found to be the radiating power of a sodium atom in a Bunsen burner, so that, if there is reason to think that any greater oscillation might disintegrate the atom, it is evident that we are still a long way from doing so. It is to be observed that ordinary light-waves are very much longer than the period of the vibration above referred to. Dr. Lodge has pointed out that quite large oscillators in comparison to molecules—namely, about the size of the rods and cones in the retina—are of the size to resound to light-waves of the length we see, and so might be used to generate such waves. This seems to show that the electro-magnetic structure of an atom must be more complicated than a small sphere or other simple shape with an oscillating charge on it, for the period of vibration of a small system can be made long by making the system complex, *e. g.*, a small Leyden jar of large capacity with a long wire wound many times round connecting its coats, could easily be constructed to produce electro-magnetic waves whose length would bear the same proportion to the size of the jar as ordinary light-waves do to an atom. The rate at which the energy of a Hertzian vibrator is transferred to the ether is so great that we would expect an atom to possess the great radiating power it has. This shows, on the other hand, how completely the vibrations of an atom must be forced by the vibrations of the ether in its neighborhood, so that atoms, being close compared with a wave-length, are, in any given small space, probably in similar phases of vibration. It is interesting to consider this in connection with the action of molecules in collision as to how far the forces between molecules after collision is the same as before. In the same connection the existence of intra-atomic electro-magnetic oscillations is interesting in the theories of anomalous dispersion. An electro-magnetic model of a prism with anomalous dispersion might be constructed out of pitch, through which conductors, each with the same rate of electro-magnetic oscillations, were dispersed. In theories of dispersion a dissipation of energy is assumed, and it may be the radiation of the induced electro-magnetic vibrations. These can evidently never be greater than the incident electro-magnetic vibration, on account of this radiation of their own energy. In some theories a vibration of something much less than the whole molecule is assumed, and the possibility of intra-atomic electro-magnetic oscillations would account for this. Some such assumption seems also required, in order to explain such secondary, if not tertiary, actions as the Hall effect and the rotation of the plane of polarization of light, which are, apparently at least, secondary actions due to a reaction of the matter set in motion by the radiation on this radiation.

Some further diagrams were exhibited, plotted from Hertz's theory by Mr. Trouton, to whom much of the matter in this paper is due. They are here reproduced, and show eight simultaneous positions of the electric and magnetic waves during a semi-oscillation of an electric oscillator. The dotted line shows the electric force at various points, and the continuous line the magnetic force. In the first diagram the magnetic force is at its maximum near the origin, while the electric force there is zero. In the second the magnetic energy near the origin has partly turned into electric energy, and consequently electric force begins. The succeeding figures show how the magnetic force decreases near the origin, while the electric force grows, and the waves already thrown off spread away. The change of magnetic force between Figs. 4 and 5 is so rapid, that a few dashed lines, showing interpolated positions, are introduced to show how it proceeds. It will be observed how a hollow comes in the line showing electric force, which gradually increases, and, crossing the line of zero force at about a quarter of a wave-length from the origin, is the source of the electric wave, which, starting with this odds, picks up and remains thenceforward coincident with the magnetic wave. From this origin of electric waves they spread out along with the magnetic waves and in towards the origin, to be reproduced again from this point on the next vibration. These electric and magnetic forces here shown as coincident are, of course, in space in directions at right angles to one another, as already explained. The corresponding diagrams for a magnetic oscillator are got by interchanging the electric and magnetic forces.

A further experiment was shown to illustrate how waves of

transverse vibration can be propagated along a straight hollow vortex in water. It was stated that what seemed a possible theory of ether and matter was that space was full of such infinite vortices in every direction, and that among them closed vortex rings represented matter threading its way through the ether. This hypothesis explains the differences in Nature as differences of motion. If it be true, ether, matter, gold, air, wood, brains, are but different motions. Where alone we can know what motion in itself is—that is, in our own brains—we *know* nothing but thought. Can we resist the conclusion that all motion is thought? Not that contradiction in terms, unconscious thought, but that all living thought; Nature is the language of One in whom we live, and move, and have our being.

ON A BALLISTIC ELECTROMETER.[1]

BY M. GOUY.

THE quadrant electrometer can be used ballistically if the usual damping arrangement is removed, and the needle suspended by a conducting wire. The impulse given to the needle by a moment M acting for a very short time is equal to $\int M\,dt$; and as M may be made proportional either to V or V^2, where V is the potential difference between the quadrants, it thus becomes possible to measure $\int V\,dt$ and $\int V^2\,dt$. Thus if the needle is charged to a high constant potential, the magnitude of the first swing is proportional to $\int V\,dt$; and if the quadrants are connected with the two terminals of a resistance R through which a quantity Q of electricity passes in a very short time it is easy to see that whatever the self-induction of the resistance R,

$$\int V\,dt = RQ.$$

This formula has been practically tested with a Mascart electrometer, whose needle was suspended with a platinum wire 0.02 mm. in diameter, and charged to a potential of 300 volts. With this instrument a discharge of one microcoulomb through a megohm gave a deflection of 130 mm. on a scale two metres off, the period of the needle oscillations being 11.6 seconds. It is necessary that the capacity of the condenser used for the discharge should not be too high, or the time taken for the discharge will prevent the electrometer acting ballistically. The action is, however, satisfactory if the product of the capacity in microfarads and the resistance in megohms does not exceed $\frac{1}{5}$th.

In this way large resistance may be conveniently measured, and, as very small quantities of electricity are used, the method is especially suitable for liquid resistances, where difficulties usually arise from polarization. If, instead of Q being known, R is known, the method is one for measuring electrical quantity; and the electrometer thus does the duty of a ballistic galvanometer. The sensibility may, however, be made very great by giving a high value to R. By a suitable modification of the method, condensers of widely different capacities may be compared, and by connecting the needle to one pair of quadrants the electrometer may be used as a ballistic electro-dynamometer.

THE OPTICS OF THE LIGHTNING FLASH.[2]

BY ERIC STUART BRUCE.

IN Mr. Shelford Bidwell's recent lecture on "Lightning" at the London Institution, I notice the author says that the lightning flash of artists has no existence in nature, and that it is an artistic fiction or symbol. May I venture to refer to a paper which I had the honor of reading before the Royal Meteorological Society (published in the current Quarterly Journal of the Society) only a few days after the delivery of Mr. Shelford Bidwell's lecture? In this paper I endeavored to show how the "zigzag" flash so often seen by observers, and frequently depicted by artists, may have its counterpart in nature, quite consistently with the evidence of the photographs of lightning flashes collected by the Royal Meteorological Society.

I suggested that such an appearance is not the flash itself, but the optically projected image of the flash formed on clouds, not of a smooth surface, but of the rocky cumulus type. The image of the flash takes the angles of the uneven surface and becomes zigzagged. I showed how this might be by casting the photograph of a lightning flash—the "streaming" flash—by means of the optical lantern, on model cumulus clouds, made of cotton wool. The "streaming" flash became distorted, and in fact zigzagged, so that it could not have been recognized as the type mentioned.

"Projection" lightning flashes surely must happen in nature, and might be accounted for in more ways than one. I will mention now one simple way which I illustrated by experiment at the meeting referred to. It is fairly well recognized that sheet lightning is the reflection of a flash on a cloud, for example; but if there happens to be the presence of a cloud with a small opening in it somewhere between the actual flash and the distant surface of clouds, then, instead of "sheet" lightning appearing on the latter, there will be "projection" lightning—that is, the image of the flash, whose shape will depend upon the shape of the cloud on which it is cast.

In speaking of zigzag representations of lightning flashes, it is important to make some distinction between the artistic zigzag and a common pictorial type such as is seen on the covers of electrical books, in dissolving views, in scenic effects, and even in street advertisements. It is hardly fair to saddle the artists with the latter class. A good specimen of an artistic zigzag flash, and one which shows an observance of nature, can be seen in Wilson's famous picture of "Celadon and Amelia."

It certainly seems at first sight strange that the "projection" flash should not be included in the photographs of lightning flashes. Its non-appearance may be due (1) to the photographic plates not being sufficiently sensitive to register a flash of diminished brilliancy, for the projected image of any source of light has not the same intensity as the source itself. (2) The "projection" flash being of rarer occurrence, the number of photographs yet taken may not have included it. If the type is rarer, it may be objected that it is not likely that artists would generally depict a rare type in preference to the more common one; but the less dazzling nature of the "projection" would be sufficient to account for its adoption, rendering the form of the flash more distinct to the average eye. To take an illustration, if an electric arc light is suddenly flashed before our eyes, we fail to distinguish the form of the white-hot carbon points, but if its image were flashed upon a screen, their form would be distinctly visible.

It is worthy of note that some painters have chosen to represent other types than what I have termed the "projection" flash. See Turner's "Stonehenge," where "streaming" lightning is pictured.

1. *Comptes Rendus.*
2. *Nature.*

POWER REQUIRED TO OPERATE CERTAIN MACHINE TOOLS.

Mr. R. E. Dunston, the president of the Connecticut Motor Co., has recently worked out the following valuable data relative to the amount of power required to operate certain machine tools, as enumerated below:

Shop shafting, $2\frac{3}{16} \times 180$ ft., at 160 revolutions, carrying 26 pulleys, varying in diam. from 6" to 36", and running 20 idle machine belts........	1.32 h. p.
Lodge-Davis upright back-geared drill-press, having table 28" swing, drilling ¾" hole in cast iron with feed of 1" per min..........................	.78 h. p.
Morse twist drill grinder, No. 2, carrying 2-6" wheels at 3,200 revolutions..........................	.29 h. p.
Pease planing machine, $30'' \times 36'' \times 6$ ft. table, planing cast iron, cut ¼" deep, planing 6 sq. in. per min., at 9 reversals.	1.06 h. p.
Shafting machine, 22" stroke, cutting steel die, 6" stroke and ⅛" deep, shaping at rate of 1.7 sq. in. per min..........................	.37 h. p.
Engine lathe, 17" swing, turning steel shaft 2⅜" diam., cut $\frac{3}{16}$" deep and feeding 7.92" per min	.43 h. p.
Engine lathe, 21" swing, boring cast-iron pole 5" diam., cut $\frac{3}{16}$" deep, feeding 3" per min................	.23 h. p.
Sturtevant Monogram blower, No. 2, at 1,800 revs., no piping	.80 h. p.
Heavy planer, $28'' \times 28''$, 14 feet bed, stroke 8", cutting steel, making 22 reversals per min..........	3.20 h. p.

"AN ELECTRIC SUCCESS."

About eight years ago last January there appeared from New York a handsomely gotten up though small paper called THE ELECTRICIAN. It was monthly, and the subscription was but fifty cents a year. It seemed to prosper, and in perhaps a year it was enlarged and the tariff doubled. Still it increased in size and circulation until later on as THE ELECTRICIAN AND ELECTRICAL ENGINEER, at a trebled price, it became famous among journals of its kind. Recently, as THE ELECTRICAL ENGINEER, it appeared as a weekly publication of from fifty to sixty pages, and is now probably the leading technical electrical periodical of America.—*San Francisco Newsdealer.*

THE RIES ELECTRIC TRACTION AND BRAKE CO.

The Ries Electric Traction and Brake Company has recently been incorporated, with a capital stock of $2,000,000, divided into 20,000 shares of $100 each.

The company has purchased the United States patents granted to Elias E. Ries for methods of, and apparatus for, increasing traction electrically, and for electric braking, and will carry on a general manufacturing business in connection with the introduction of its electric traction increasing and brake appliances. The incorporators and officers of the company are John M. Denison, president; John B. McDonald, vice-president; James Sloan, Jr., treasurer; Elias E. Ries, consulting electrician; Charles Selden, director; John W. Snyder, director; and Charles H. Jones, Jr. The principal offices of the company are in the Chamber of Commerce building, Baltimore. Satisfactory experimental trials of the apparatus have already been made, and further tests on a more extensive scale are now under way at Mount Clare.

ON THE ELECTRO-DEPOSITION OF PLATINUM.[1]

BY WM. H. WAHL.

Thus far, of all the methods that have been proposed for electro-plating with platinum, three only appear to have sufficient merit to deserve special notice; these are:

1. Roseleur-Lanaux method, based on the electrolysis of a solution of the double phosphate of sodium and platinum.

2. The process of the Bright Platinum Plating Company (of London), a modification of that of Roseleur, involving the introduction into the bath of certain substances, such as sodium chloride and borax, to ensure a bright deposit of the metal; and

3. Boettger's method, founded on the electrolysis of a solution of the double chloride of ammonium and platinum in sodium citrate.

Each of these baths will yield satisfactory results for a time; but the peculiar difficulties met with in the practice of platinum-plating render it impossible to maintain the chemical integrity of these electrolytes, and, in consequence thereof, they soon become inefficient or inoperative by reason of contamination with the secondary products formed therein.

The first difficulty encountered is that of obtaining a bright, reguline and adherent deposit of the metal, in which form only it will answer the demands of practice. Another and no less serious difficulty arises from the insolubility of plates or sheets of this metal as anodes, when solutions containing platinum salts are submitted to electrolysis.

It results from this want of solubility of the anode that the metallic strength of the electrolyte employed is continuously being weakened while the deposition of the metal is going on, and the conductivity of the bath is being continually modified thereby. The character of the deposited metal also is injuriously influenced by these constant alterations of condition in the bath; and, as the rate of deposition becomes slower and slower by reason of the gradual impoverishment of the metallic strength of the solution, it will be necessary to restore it by fresh additions of metallic salt.

It occurred to me that it might be practicable to overcome the principal difficulty here set forth. Knowing the influence of extent of surface in promoting the solubility of substances, it appeared to me at least probable that if the platinum were exhibited at the anode in the form of platinum-black, or sponge, exposing thus an enormously greater number of points of attack to the electro-negative element or acid radical there set free, the result might be the solution of the platinum, and the problem of maintaining the metallic strength of the electrolyte would thus be solved. The correctness of this conjecture was verified by experiment. For this purpose a plate of porous battery carbon, previously treated with boiling hydrochloric and nitric acids, was saturated repeatedly with a solution of platinic chloride and dried. It was then introduced into a graphite crucible, finely divided carbon was packed about it, and the crucible and contents heated for about half an hour to bright redness. The carbon plate then contained within its pores platinum in a state of eminently fine division. Treatment with water, and with hydrochloric acid at boiling temperature, failed to leach out any platinum salt, showing that the previous treatment had sufficed to reduce all the platinum salt to the metallic state. The carbon plate was then suspended as the anode in moderately diluted hydrochloric acid, a platinum plate serving as the cathode. The acid bath was gently heated and a current of moderate strength was allowed to flow through it. There was a liberal evolution of hydrogen from the cathode, but little perceptible evolution from the anode. The acid solution gradually became colored from the formation of platinic chloride, and after some time the bright surface of the cathode began to blacken and ultimately became covered with a thick coating of platinum black. It was thus demonstrated that an anode of platinum in a fine state of division is readily soluble in an electrolyte which yields chlorine at the anode when the same is electrolyzed. This observation, so far as I am aware, is new. It proved, however, to have no practical value, since the solution of the anode demanded the presence of a large proportion of free acid in the plating-bath and the use of currents of such strength as to produce invariably the deposition on the surfaces to be plated, of black and non-adherent metal. Furthermore, it was found as was to have been anticipated, that the physicial condition of the anode exerted no influence whatever in the electrolysis of baths formed of the oxy-salts of platinum, from which the best results in electro-plating are obtained—since, in electrolyzing such compounds, the acid radical separated upon the surface of the platinum black failed to exert any perceptible solvent action.

It was therefore necessary to devise some other plan for overcoming the difficulties herein described, and, after making a number of fruitless experiments, I was so fortunate as to find a plan which appears to offer a solution of the troublesome problem of electro-plating with the group of metals, whose anodes are insoluble, in a more satisfactory manner than any other that has hitherto been suggested.

The plan here referred to consists in employing platinum hydroxide for the purpose of maintaining the metallic strength of the plating-bath. For this purpose, the hydroxide, which is readily soluble in alkalies and in many of the acids, may be introduced into the plating-bath from time to time and dissolved therein by stirring, or it may be permitted to remain in the bath in excess, the undissolved portion remaining at the bottom of the containing vessel, or it may be suspended in a canvas-bag adjacent to or surrounding the anode of carbon, according as the nature of the electrolyte may indicate one or the other method to be the preferable one. As the solutions which yield the best results in plating are those of the oxygen salts, I have found it advantageous also to prepare these directly from the hydroxide. This method, I have found, is capable of yielding a number of electrolytic baths of platinum that will maintain their metallic strength approximately unimpaired during the electrolysis, and without the objectionable features of introducing into them substances that will cause them to deteriorate by the accumulation therein of injurious secondary products of decomposition, as is the case where such baths are maintained by additions of platinic chloride or alkaline chloro-platinates, as has hitherto been the invariable practice.

I append directions for the preparation of several electrolytic baths and indicate what I have found to be the most favorable conditions for working them.

Directions for Preparing the Electro-Plating Baths.—For the alkaline platinate bath, the following directions may suffice:

Platinic hydrate.	2 oz.
Caustic potassa (or soda)...	8 oz.
Distilled water...............	1 gallon.

Dissolve one-half of the caustic potassa in a quart of distilled water; add to this the platinic hydrate in small quantity at a time, facilitating solution by stirring with a glass rod. When solution is effected, stir in the other half of alkali dissolved in a quart of water to form one gallon of solution. To hasten solution, the caustic alkali may be gently heated, but this is not necessary, as the platinic hydrate dissolves very freely. This solution should be worked with a current of about two volts and will yield metal of an almost silvery whiteness upon polished surfaces of copper and brass, and quite freely. There should be slight, if any, perceptible evolution of hydrogen at the cathode, but a liberal evolution of oxygen at the anode. I have observed that the addition of a small proportion of acetic acid to this bath improves its operation where a heavy deposit is desired. The anode may be of platinum or carbon, and, owing to the readiness with which the metal is deposited, an excess of anode surface is to be avoided. Articles of steel, nickel, tin, zinc, or german-silver, will be coated with black and more or less non-adherent platinum; but by giving objects of these metals a preliminary thin electro-deposit of copper in the hot cyanide bath, they may be electro-platinized in the alkaline platinate bath equally as well as copper. The bath may be worked hot or cold, but it is recommended to work it at a temperature not exceeding 100° F. It may be diluted to one-half the strength indicated in the formula and still yield excellent results. The surface of the objects should be highly polished by buffing, or otherwise, prior to their introduction in the bath, if the resulting deposit is designed to be brilliant.

The deposition of platinum takes place promptly. In five minutes, a sufficiently heavy coating will be obtained for most purposes. The deposited metal is so soft, however, that it requires to be buffed very lightly. A heavier deposit will appear gray in color, but will accept the characteristic lustre of platinum beneath the burnisher.

The oxalate solution is prepared by dissolving one ounce of platinic hydrate in four ounces of oxalic acid and diluting the solution to the volume of one gallon with distilled water. The solution should be kept acidified by the occasional addition of some oxalic acid. The simplest plan of using this bath, and which requires no attention to proportions, is simply to work with a saturated solution of the oxalate, keeping an undissolved excess always present at the bottom of the vessel. An addition of a small quantity of oxalic acid now and again will be found advantageous. The double salts of oxalic acid with platinum and the alkalies may be formed by saturating the oxalate of the desired alkali with platinic hydrate and maintaining the bath in normal metallic strength by the presence of an undissolved residuum of platinous oxalate.

The double oxalates are not so soluble in water as the simple salt. The oxalate baths, both of single and double salts, may be worked cold or hot (though not to exceed 150° F.), with a current of comparatively low pressure. The metal will deposit bright, reguline and adherent on copper and brass. Other metallic objects must receive a preliminary coppering as above. The deposited metal is dense, with a steely appearance, and can be obtained of any desired thickness.

The deposit obtained in the oxalate baths is sensibly harder than that from the alkaline platinate bath, and will bear buffing tolerably well.

The phosphate bath may be prepared by the following formula:

1. Abstract of a paper read before the Chemical Section of the Franklin Institute, May 20, 1890.

Phosphoric acid, syrupy (sp. gr. 1.7)........	8 oz.
Platinic hydrate........................ ...	1–1½ oz.
Distilled water....	1 gallon.

The acid should be moderately diluted with distilled water, and the solution of the hydrate effected at the boiling temperature. Water should be added cautiously from time to time to supply that lost by evaporation. When solution has taken place, the same should be diluted with sufficient water to make the volume one gallon. The solution may be worked cold or warm to 100° F., and with a current much stronger than that required for the platinates and oxalates. The ammonio- (and sodio)- platinic phosphates may be formed from the simple phosphate by carefully neutralizing the solution of the phosphate with ammonia (or soda); then adding an excess of phosphoric acid, or enough to dissolve the precipitate formed and an additional quantity to ensure a moderate amount of free phosphoric acid in the bath. The phosphate baths will be maintained of normal strength by additions of platinic hydrate, the solutions of which will have to be assisted by heating the bath, preferably at the close of each day's work. The metal yielded by the electrolysis of these phosphate solutions is brilliant and adherent. It has the same steely appearance as that exhibited by the oxalate solutions, but to a less pronounced degree. The physical properties of the deposited metal are in other respects like those described in connection with that obtained from the oxalate baths.

CORRESPONDENCE.

ST. LOUIS.

Electric Railway Extensions—Conversion of Cable Roads to Electrical—A New Electric Light Company.

MR. JOHN SCULLIN, president of the Union Depot Railroad, is so well pleased with his electric road that he has given orders for the enlargement of the power-house, and the installment of 1000 additional horse-power. The Mound City Railway, of which Mr. Scullin is president, is being equipped for electric power, and will be supplied with current from the Union Depot power-house.

The Lindell Railway Company, although pushing their work with all vigor possible, will not be in operation on their down town lines short of 90 days.

The Cable and Western Railroad has been sold by order of Court. Lee, Higginson & Co., of Boston, were the successful bidders at $150,000. As a result of this the St. Louis and Suburban Railroad has been incorporated with a capital stock of $2,000,000 for the purpose of acquiring the old Cable and Western property, which property, including an electric railway franchise, has been transferred to the newly formed company. Preparations are being made for the electrical equipment, and as Lee, Higginson & Co. are heavily interested in the Thomson-Houston Electric Co., it is likely that the Thomson-Houston system will be used.

The Short electric cars are now in successful operation on the South end of the St. Louis Railroad. Eight cars with trailers are in use.

The Peoples' Gas and Electric Light Company have filed articles of incorporation, capital stock $50,000, fully paid. This company have a bill before the Municipal Assembly for a franchise.

ST. LOUIS, July 10, 1890.

CHICAGO.

Elevated Railroad Work—Pullman Street Car Shops.

IT is reported that work on the South Side Elevated Road, which is being built in the alleys between the houses, thereby not disfiguring the avenues and boulevards, will be resumed in the course of a few days, and that the second mile of the structure will be completed two weeks later. At the present time only one mile of the road is finished between Twenty-ninth and Thirty-ninth streets. The company cannot build further south because the ordinance only provides for a road from Thirty-ninth street to Van Buren, and at the north work is blocked by the property owners. A condemnation suit will shortly come up, and as soon as damages shall have been assessed and property owners satisfied work on the alley elevated road will begin. President Clark says all necessary material is on hand and that the actual work of constructing the next mile of the road will not require more than 10 days. He also says that by January 1st next, 4 miles of the road will be in operation, and that before the World's Fair opens the company will be able to land passengers at the entrance. The road will have branches to various southern and southwestern sections now being developed. According to President Clark every engine will haul 3 or 4 coaches, containing seventy-five persons each, and the trains will run every 5 minutes to enable about 4,000 people to reach the Fair from the heart of the city every hour. The road is to be provided with handsome stations. It is sincerely to be hoped that electric locomotives will be employed for operating this road, as their many advantages have been demonstrated in New York and elsewhere. Any addition to the present smoke nuisance by adding steam locomotives in the resident districts should be immediately vetoed. Not only can electricity do the work, but it can perform it more economically, more safely and in a better manner than by any other means, and an elevated suburban railway is an ideal point to locate an electrical system.

The new extension of the street car shops at Pullman is nearly completed and will be ready for use in a short time. Poles are being erected along the line of the electric railway there on which wires will be strung right away. It is rumored that the Westinghouse Company are considering a proposition from Mr. Pullman to erect a joint plant near Chicago for the construction of electric railway cars and electric motors. It is hoped to enlist Chicago capital in the enterprise, and if this is accomplished the arrangement proposed will be carried out with Mr. Pullman.

CHICAGO, July 11, 1890.

PITTSBURGH.

Double Deck Car Service—The Dahl Storage Battery—Electric Railway Franchises.

Rapid Transit Work.—Recognizing Faithful Service.—Trying to Use Electricity for Suicidal Purposes.

THE Pleasant Valley street railway company in this city is about to try the experiment of a novel car-service line, by using what is commonly called a double-decker. A number of workmen have been engaged in the construction of this car at the company's shops in Allegheny City. It is modelled after the double-deckers which have been very successfully used on the street car lines in London, England. The car is much longer than the present ones in use. It will have 14 windows on each side and an inside seating capacity of 42 passengers. On the roof are two long seats placed back to back except leaving sufficient space for the operation of the trolley pole. The upper deck seats will accommodate 28 passengers. The roof will be reached by means of steps placed at each end of the car.

Mr. Stephen Dahl, an electrician employed by the Pittsburg, Allegheny and Manchester Railroad Company, is now experimenting with a new storage battery system, for which it is claimed that the material used in its construction is exceedingly light, and therefore peculiarly adapted for transportation in a street car. If the system proves a success, the company intends to adopt it on its lines.

At the last meeting of city council, a large number of railroad franchises were granted to several corporations, all of them intending to operate electric railroad on their lines. These are: The Pittsburg and Mt. Lebanon Railway Company; the McKean Street Railway Company; the Jane Street Railway Company; the Arlington Avenue Railway Company, and the Bingham Street Railway Company. All these roads will be operated by electric motive power.

PITTSBURGH, July 4, 1890.

The procession for rapid transit is steadily moving along in this city. Several gangs of workmen are occupied on the different lines of the Duquesne Traction Company's road and the tracks have already been laid upon the major portion of the streets which this system is to traverse. The management is hurrying the work to its utmost and bids fair to make good its original promise that the roads shall be in running order by October. A similar activity is manifest on the Birmingham traction line. The latter is now building an addition to the Smithfield street bridge which will be exclusively utilized for the electric cars of the company.

The conductors and motor men of the Second Avenue Electric Railway Company had quite a treat given them a few days ago. On the fourth instant, the road was unusually busy, all the cars being run from early morning until late at night, and the men worked 15 hours without interruption. Ten thousand passengers were carried on the road that day and the management, to show its appreciation of the men's work, especially as not the slightest accident had occurred during the entire time, determined to give the employés a banquet. It is needless to say that this recognition of the men's work was very gratifying to them.

Alfred Ray, a well-known resident of Lima, O., attempted to commit suicide the other day by catching hold of the electric wires in that town. His wife however surprised him in the act and summoned several neighbors, who prevented Ray from accomplishing his wish. This is the first case on record in this part of the state, of an attempt to commit suicide through the agency of electricity.

July 11, 1890.

H. N. ROWELL has been appointed superintendent of telegraph of all the divisions of the Boston and Maine Railroad.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.
Anonymous communications cannot be noticed.
The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.
In order to facilitate reference, correspondents, when referring to any letter previously inserted, will oblige by mentioning the serial number of such letter, and of the page on which it appears.
Sketches and drawings for illustrations should be on separate pieces of paper.
All communications should be addressed EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

THE SPECIFIC RESISTANCE OF COPPER.

[128.]—I have read with much interest the articles by Mr. Geo. B. Prescott, Jr., on "The Specific Resistance of Metals and Alloys" (ELECTRICAL ENGINEER, April 30 and May 7), for I have been experimenting in a similar direction a little during the past winter, and have produced samples exceeding in conductivity as much as three-quarters of one per cent., the figures laid down by Jenkin and Matthiessen.

I have just had a sample tested, which gives the following results:—Length, 8 feet 11 inches; mean diameter, .03423 inch.; weight, 14.441 grammes; temperature, 24.3° C., the resistance in legal ohms was .08083 observed; but R=.08057 by calculation as annealed wire.

MOSES G. FARMER.

Eliot, Me.

TELEGRAPH OPERATORS AS ELECTRICAL ENGINEERS.

[129.]—In your editorial relating to the New York *Sun's* article on the migration of telegraphers to other fields, you exhibit surprise at their endeavor to secure "promotion and riches" by a different route from that they started on, and make a few suggestions as to the probable cause.

Usually, operators start to learn their trade when very young, when twenty-five dollars a month seems a small fortune to them. As they get older, and the fascination wears off, the very monotony makes them dissatisfied, and with new responsibilities to shoulder, even if they reach the point where they receive the highest salary paid for telegraphic work, they seek to better themselves. Some enter other professions from a recognition of their adaptation for some particular pursuit, and fortunate is he who knows in what line he is best capable of success. The majority of those who examine the electrical field see everything through telegraphic eyes. Long years of service in this one line have placed a film over their eye-sight and they are imbued with the idea that the whole electrical field centers in the telegraph companies. The farthest they see is a chiefship with a probable increase of five or ten dollars to the pittance they now receive, with kicks from those above and abuse from those below. They do not see any benefit to be derived from four or five years' duty of quads and duplexes. If you ask any old operator why he does not study the higher branches of his profession, he will probably refer to a number of electricians in the telegraph service no better off than himself, or say "Some chief will think I want his position and I will be discharged the first chance they get at me." I have heard such remarks as this dozens of times, and it seems to be the prevailing idea. So long as this feeling exists, electrical engineering can expect no recruits from the telegraphers. Formerly, they were the only source to draw from, but with the placing of electrical engineering as a feature of college tuition, others have had the advantage of beginning in the higher paths without passing through the various grades of messenger, office boy and operator. Besides this, they get thorough instruction in the most essential part of engineering—mathematics. To be a *skilled* electrical engineer, one must be a good mathematician, a fair chemist, a clever mechanic, an inventor, and have sufficient energy to overcome all obstacles. This implies clear perception, sound judgment and keen reasoning powers; the ability to think for one's self without following the text-books, which are often very misleading.

When the time required to become an electrical expert is compared with the two or three years' study necessary to master some other profession, it is not surprising that telegraphers give it the go-by. They only see remuneration in becoming an Edison or a Jones, and think it useless to strive for something beyond their reach. They lack the necessary energy, and either enter other fields or remain where they are. Numbers of them would make fine electricians if they could only think with Bulwer that,

"Whoever, with an earnest soul,
Strives for some end from this low world afar;
Still upward travels, though he miss the goal,
And strays—but towards a star."

G. H. GOODFELLOW.

New York, July 12th, 1890.

CONSOLIDATION OF THE EDISON INTERESTS.

SOME weeks ago we gave first publicity to reports then current only in well informed circles as to the changes about to be made in the management of the Edison lighting and power interests. The course of events has since shown those reports to be accurate, as the changes then only contemplated have since been made, or will shortly be consummated. While the usual reticence in dealing with inquiries of the kind is strictly maintained at the offices of the Edison General Electric Company, we have reason to believe that our information as given below outlining the new departure is to be relied upon, and is thoroughly correct in almost every detail.

The reorganization is far more comprehensive and important than appears at first sight. If all that be said is true, it means, for the first thing, that Mr. Edison himself will devote by far the greater portion of his time to the development of apparatus for the Edison General Electric Company, in all its various fields of work, and especially in some of the newer ones. This statement seems to be borne out by the fact that Mr. Samuel Insull, who stands so close to Mr. Edison in a confidential relationship, is, in his new capacity of Second Vice-President of the company, taking, if possible, a more active part than ever in its business management, by having all the manufacturing and selling departments directly under his control and supervision. Mr. J. H. Herrick, the First Vice-President, will take charge of the finances, a matter of no small moment in such a large and progressive enterprise.

Another interesting feature of this new organization is that various districts have been created, each of which will handle the whole business in its given territory, subject, of course, to the central authority. Mr. C. D. Shain, of the United Edison Manufacturing Company, has been appointed manager of the Eastern District, with headquarters in New York City. Mr. O. T. Crosby, late of the Weems and Sprague Companies, has been appointed manager of the Southern District, with headquarters at New Orleans; Mr. G. W. Coster, formerly of the United Edison Company, has been appointed manager of the Rocky Mountain District, with headquarters at Denver. Mr. W. S. Heger is appointed manager of the Pacific Coast District, with headquarters at San Francisco. Last, but by no means least, comes the appointment at Chicago, for the Central District, and it is now understood that this position goes to Mr. John I. Beggs, who will resign as vice-president of the local Edison Company of this city to take it. One detail of this important mapping out of the country is that each district will also have its own engineer and auditor associated with the manager, and thus the work will be systemized and properly cared for at each point. The Canadian District will be managed by Mr. M. D. Barr, with headquarters at Toronto. These districts constitute branches of the Edison General Electric Company, all other agencies and interests being merged, losing not only their name but their identity.

This disposes of the arrangements outside New York. In the city, one of the first steps has been the shutting down of the old United Edison headquarters at 65 Fifth avenue. Pending the completion of the fine new Edison building, eight stories in height, running through from Broad street to New, the engineering department of the United Company has been located with one or two other divisions at 52 and 68 Broad street, while the accounting department goes to the headquarters at 44 Wall. At 16 and 18 Broad street, for the time, will be located the office of the Second Vice-President and of the factory and sales departments reporting to him. Mr. J. Muir will, thus, under the reorganization, be general manager of the railway department of the Edison General Electric Company. Mr. H. Ward Leonard will be general manager of the General Company's light and power department, including isolated plants and stationary motor work, as well as the transmission of power. Mr. J. F. Kelly will have charge of the wire department as its manager.

It is said that the vast manufacturing departments will each be in responsible hands, and that a division will be made of them into "mechanical" and "lamp manufacturing." Mr. John Kruesi, who has been Mr. Insull's "right hand" at Schenectady, will be general manager of the "mechanical" branch, and Mr. W. E. Gilmore, who is not generally known outside the Edison business, but has already earned a high reputation for ability and energy, will be his assistant at Schenectady. Mr. Kruesi's assistant at Bergmann & Co.'s, in this city, will be Mr. J. Hutchinson; and the Canadian shops will continue in charge of Mr. John Langton. The other main department, that of "incandescent lamp manufacturing," will be in charge of Mr. F. R. Upton, who will remain in practically the same position as before. With Mr. Insull, as his assistant at headquarters, will be Mr. S. D. Greene, now in charge temporarily at Chicago.

So far as can be ascertained, these are the main changes or new appointments, subject possibly to a slight modification or two. The plan for amalgamating the various interests and departments is one that has evidently been laid out in a masterly manner, and should be productive, as soon as a very little time has elapsed, of the best results in the development of a great industry.

REPORTS OF COMPANIES.

THE WESTINGHOUSE ELECTRIC COMPANY.

A meeting of the stockholders of the Westinghouse Electric Company took place on July 8, at the offices of the company in the Westinghouse Building, Pittsburgh, Pa. At this meeting the formal transfer of the stock of the Westinghouse Electric Company to the Westinghouse Electric and Manufacturing Company was made.

After that a proposition was laid before the stockholders for an increase of the capital stock of the company from $5,000,000 to $10,000,000. A resolution having been passed to this effect, the matter was put to a vote, which lasted an hour. At the termination of this period nearly 80,000 shares had been voted and every one had been cast in favor of the increase.

Mr. George Westinghouse, Jr., made the following statement to the meeting:

This company has now acquired the outstanding shares of the Westinghouse Electric Company, and by an action of a meeting of the stockholders of that company held July 7, 1890, has succeeded to its property and business.

The company began the manufacture and sale of continuous apparatus for incandescent lighting in 1886, which apparatus, however, could be commercially successful only for isolated lighting and central stations within moderate limits. Its capital was fixed at $5,000,000, with the expectation that that amount would meet the requirements of the business.

For the purpose of supplying apparatus for the distribution of electric light and power from central stations over large areas, it took up the alternating current system in 1886, up to which time none of the companies engaged in the business in the United States had considered that system commercially practicable; and it thus entered a field entirely its own.

To protect its business and successfully defend itself in any litigation that might be forced upon it by its competitors, the company found it desirable to fortify its patent position, and to that end acquired the control of the Consolidated Electric Lighting Company and the United States Electric Lighting Company, both of New York. The Consolidated Company was the successor of the Electro-Dynamic Light Company of New York, the first company organized in the United States for the manufacture and sale of electric incandescent lamps, and the owner of a large number of patents of date prior to those upon which rival companies were depending. The company purchased nearly one-half of the capital stock of the Consolidated Company, and subsequently leased it at a rental equal to 6 per cent. per annum on its capital of $2,500,000.

The United States Company was organized in 1878, a few weeks after the Electro-Dynamic Company, and was the successor of the oldest company in the United States for the manufacture of electric power apparatus, and also owned a large number of early patents covering every necessary detail of lighting and power plants. The company purchased $700,000 of a total of $1,500,000 capital stock of the United States Company, and leased its patents and business at a rental which will ultimately equal 6 per cent. per annum on its capital stock. In addition to their patents these two companies had large and flourishing businesses and manufacturing plants, which were also acquired by the leases.

These purchases have greatly increased the standing and influence of the company, which now owns and controls 632 patents relating to electric lighting and power, and has now pending over two hundred applications for patents for inventions necessary or desirable to the manufacture and operation of the latest improved forms of apparatus.

The success of the company is best illustrated by the report for 1889 already submitted, during which year the sales of the company and its leased companies amounted to $4,362,115.22, yielding a net profit of $729,307.87, after paying very heavy extraordinary charges incident to a new business of this character.

No branch of the electric business yields such large profits as the railway business, and the company has already entered this field. It has assured to itself the necessary patent protection to enable it to carry on the manufacture and sale of such appliances, and during the last three years has given close attention to the details of this class of apparatus; but it has refrained from selling the same until it could supply its customers with efficient and reliable equipments. The experience of users with the defective apparatus heretofore rushed out by other companies, fully justifies the wisdom of the company's action in this respect.

To-day the company is in receipt of orders and inquiries from all parts of the country, and has actually completed contracts for the equipment of 17 railways, aggregating $300,000, these orders having been received during the last 60 days. The volume of business offering to the company in this line indicates that its total out-put from the first of July this year to the first of July, 1891, may be doubled by the provision of adequate capital for carrying on this increased business, and with more than a corresponding increase in the returns. To enable the management to reap the greatest profit, the company should be placed in a position by its stockholders to do its business on a cash basis, and it should have available sufficient capital to take advantage of all profitable business offered to it.

The necessity for a large capital for a general electric business has been shown by the action of its two competitors: the Thomson-Houston Company having authority to issue $15,000,000, of which $11,500,000 have already been sold; while the Edison General Company has an issued capital of $12,000,000, which, according to its report to the Listing Committee of the New York Stock Exchange, is still insufficient to carry on an extended business.

The Board of Directors are of the opinion that a total increase in the capital stock of not less than $5,000,000, should now be authorized in order to provide for the future requirements of the company: $3,000,000 of which may be issued by the directors from time to time as in their judgment may be deemed best, and the issue of the remaining $2,000,000, to be subject to the approval of a special meeting of the stockholders called for that purpose.

It is proposed to issue forthwith to each stockholder of record on this date, an assignable right to subscribe on or before August 1, 1890, for one-half share of stock for each share now standing in his name on the books of the company, at $40 per share, this price being determined by a distribution or an allowance from the surplus earnings. Of this price one-quarter will be payable on August 1, one-quarter September 1, one-quarter October 1 and one-quarter November 1.

Mr. George Westinghouse, Jr., has agreed to take $1,250,000 of stock on the terms above indicated. If each of the other stockholders will subscribe to the number of shares to which he is entitled, the company will be enabled to provide for a large increase in its business. The Board believe it to be to the pecuniary interest of each stockholder to subscribe for his amount of stock, and thereby aid in increasing the earning capacity of the company, which will have the immediate effect of enhancing the value of the shares already outstanding, and of the shares which in this manner will be secured at a reduced rate.

The Board believed that great profit would accrue to the company by securing foreign patents on the more important of the inventions exploited by it in this country. This policy resulted in an order from the Metropolitan Electric Supply Company, Limited, of London, for a central station of 10,000 lights capacity, which has since been increased to 25,000. The station is now in operation with entire satisfaction, and is the most complete and perfect central station in Europe. A company known as the Westinghouse Electric Company, Limited, has been organized in London, to operate these patents, and this company has received in payment for the patents and the money expended in the development of that business £301,000 of the stock of that company, which is the controlling interest. The English company has recently received orders for other plants, and is in negotiations for others of a very extensive character, with every prospect of success. Indeed, the business abroad bids fair to reach proportions that will equal, if not be greater than, those of the parent company, and to be a source of great profit to it. The majority of the Board of the Westinghouse Electric Company, Limited, are also members of the Westinghouse Brake Company, Limited, of London, and the business is being conducted on the same lines which rendered the latter company so successful. Its operations are under the supervision and direction of Mr. H. M. Byllesby, the Vice President of this company, who is its Managing Director, and is now in England giving it his personal attention.

The following is a statement showing the financial condition of the company on June 1 of this year:

		June 1, 1890.
Cash		$ 74,508 58
Accounts receivable		1,341,535 56
Due from leased companies for cash advanced		539,591 33
Material in stock at cost		516,029 25
Material purchased for Newark factory		338,837 11
Real estate and buildings		401,854 75
Machinery, tools and fixtures		344,301 57
Stock in United States Electric Lighting, Consolidated and other companies, bought		1,597,664 18
Stocks and Bonds received in settlement of Accounts, and for Franchises		322,967 60
Stock of Westinghouse Electric Co., Limited		1,449,462 40
Charters, Franchises, etc		83,751 16
		$7,010,498 49
Patents: Some 632 patents covering the alternating current system, arc and incandescent, Tesla motor and other lines of manufacture of this company		4,111,312 09
Total Assets		$11,121,810 58
Liabilities.		
Bills payable, secured by collateral	$1,228,500 00	
Bills payable outstanding for merchandise	317,011 48	
Bills payable for sundries	116,666 66	
Accounts payable	368,541 61	
Bills payable, given in purchase of shares of United States Electric Lighting Co., payable $37,500 quarterly	575,000 00	
Bills payable given in purchase of Newark store-room stock, payable in monthly installments of about $15,000 each	324,269 48	
Cash advanced by Mr. George Westinghouse, Jr.	1,241,705 42	
	$4,161,694 00	
Capital stock	$4,998,150 00	
		$9,159,844 00
Surplus		$1,961,966 58

STOCKS AND BONDS.

WOOSTER, O.—The Wooster Schuyler Electric Light Co. has changed its name to the Wooster Electric Co. and increased its capital stock from $25,000 to $50,000.

THE THOMSON-HOUSTON DEBENTURE BOND COMPANY has been organized, and the first issue of bonds—$1,000,000—will be made within a week or 10 days.

THOMSON-HOUSTON STOCK.—The Thomson-Houston common stock, trusteed or "pooled" for 30 days, for sale, is now being held for 90 days more by the trustees, not a share having been withdrawn from the pool. The 120 days date from June 5.

THE SYRACUSE CONSOLIDATED STREET RAILWAY CO. is to issue $1,000,000 of first mortgage 5 per cent. 30-year gold bonds. The company consolidates nine systems with 30 miles of track, and is to adopt electricity for the whole. The roads are now earning about $200,000 gross and $75,000 net.

MALDEN, MASS.—Having lately increased its capital stock from $100,000 to $150,000, the Malden Electric Co. offers stockholders of record July 2 the right to subscribe until Aug. 15 for one new share at par, $100 for every two shares now held, payments to be made in cash on or before Aug. 15 Rights are assignable. The proceeds of the stock are for new plant, which promises to increase the income in greater ratio than the increase of capital. The company pays 8 per cent. on its present stock, and Treasurer C. W. Royce says it can do the same on the new capital.

NEW YORK SUBWAY BONDS.—First and second mortgages on the franchises, working apparatus, etc., of the Consolidated Telegraph and Electrical Subway Company, consisting of the telegraph, electric light and telephone companies, and the Edison Illuminating Company, of this city, were filed recently in the Register's office. The first mortgage is executed to the Atlantic and the second to the Mercantile Trust Company. The mortgages are to secure an issue of $4,750,000 worth of bonds, or $2,375,000 each. The telegraph and telephone companies will issue $1,125,000 worth of bonds, the electric light companies an equal amount, and the Edison Company $125,000 under each mortgage. The issue will be of 6 per cent. bonds for $1,000 each, payable June 1, 1940, or redeemable earlier, at the option of the company, after six months' notice, on payment of accrued interest and 10 per cent. premium on the par value.

The issue of bonds was decided on at a meeting of the Board of Directors of the Consolidated Company held May 20 last to raise money for the construction of subways throughout the city.

SOCIETY AND CLUB NOTES.

THE ATLANTA ELECTRIC CLUB.

The Atlanta (Ga.) Electric Club recently organized with a charter membership of about forty members, and fifteen recent applications for members. Their club rooms are located in the direct business centre of the city, very tastefully furnished, and lighted with a unique arrangement of incandescent lights supplied by the Thomson-Houston Co. They have telephone connections, call boxes with the Western Union and Postal service, and instruments connecting with the same companies, phonograph, and phonograph-graphophone, reading room, billiard and pool tables, grand piano, and everything arranged for the best comfort of the members, and their out of town friends. All the principal electrical men of Atlanta and vicinity are members, and the club is an assured success.

LEGAL NOTES.

A NEW YORK SUBWAY SUIT.

The North American Underground Telegraph and Electric Company has brought suit in the Supreme Court against the Consolidated Telegraph and Electrical Subway Company and the New York Underground Telegraph Company for $2,500,000 damages and to compel the subway company to take down overhead wires in this city and place them in a conduit owned by the plaintiff. It is charged that the Western Union Telegraph Company and the American Bell Telephone Company have gained control of the subway company in order to prevent the further tearing down of overhead wires.

In March, 1888, the complaint sets forth, the subway company agreed with the plaintiff corporation for the use and operation of the Johnstone underground system. The New York Underground Telegraph Company became a party to the agreement, being possessed of certain grants and privileges. The Johnstone system was adopted and a number of miles of the conduit was laid. Then the work was suddenly suspended.

This is laid at the door of the Western Union and the Bell Company, controlling the Metropolitan Telegraph and Telephone Company, and through it the subway company. It is further charged that the defendants have resorted to laying useless conduits in order to make the public believe that an underground system was impracticable.

ELECTRIC RAILWAY LITIGATION IN PITTSBURGH.

A special dispatch from Pittsburgh of July 7, says:—Three bills in equity and one action at law were filed in the United States Circuit Court to-day by the Westinghouse electric people. The titles of the suits are George Westinghouse, Jr., *vs.* The Wilkinsburg Electric Company; The Westinghouse Electric Company *vs.* The Wilkinsburg Electric Company; The Westinghouse Electric Company *vs.* The Second Avenue Passenger Railway Company, and the Westinghouse Electric and Manufacturing Company *vs.* The Second Avenue Passenger Railway Company.

In the action at law damages are claimed to the amount of $50,000. The Thomson-Houston company is aimed at in the action brought against the Second avenue electric line, as the company is operating the Thomson-Houston system.

DELAYED TELEGRAM.—HANNAH JOSEPH vs. W. U. TEL. CO.

The Western Union Telegraph Company was sued for $25,000 in the Chicago Federal Court by Mrs. Hannah Joseph. The plaintiff is the wife of a traveling salesman who, while at Paxton, Ill., one Saturday evening, telegraphed his wife that he would be home the following day. He did not come, and Mrs. Joseph was seized with hysterics, which a physician said were the commencement of a more serious disorder. Mrs. Joseph sent a message to her husband asking him why he did not come, but did not receive a reply until the following day. During all that time she suffered great agony. Judge Gresham heard the evidence yesterday and instructed the jury that, while the company was liable for the delay in delivering the telegrams, Mrs. Joseph's sufferings commenced before she sent the message, and she could only recover the price paid for tolls. A verdict for 25 cents was returned.

INVENTORS' RECORD.

Patents issued July 8, 1890.

Alarms and Signals:—*Electric Signaling Apparatus*, G. B. Lehy, 431,597. *Signaling Apparatus*, G. B. Lehy, 431,598. *Boiler Alarm*, D. Focer, 431,885. *Automatic Fire-Alarms*, H. E. Jacobs,, 431,979.

Conductors, Conduits and Insulators:—*Subway for Electric Cables*, W. L. Parsley, 431,780. *Metallic Pole for Electric Wires*, etc., J. P. Schnieder and D. K. Carson, 431,955.

Distribution:—*Apparatus for Electrical Conversion*, E. N. Dickerson, Jr., 431,879.

Dynamos and Motors:—*Magneto-Electric Machine*, A. S. Colgate, 431,559. *Regulator for Dynamo Electric Machines*, G. A. Polson, 431,618. *Electric Motor Apparatus*, S. C. C. Currie, 431,649. *Dynamo*, E. H. Johnson, 431,812.

Galvanic Batteries:—*Galvanic Battery*, C. R. Goodwin, 431,742. *Composition for Porous Carbon Structures*, C. R. Goodwin, 431,743. *Process of Forming Porous Pots for Voltaic Batteries*, C. R. Goodwin, 431,968.

Lamps and Appurtenances:—*Incandescent Lamp Socket*, J. J. Wood, 431,681. *Means for Attaching and Detaching Electric Lamp Bulbs*, S. J. Jacobs, 431,721. *Incandescent Lamp*, G. R. Lean, 431,776.

Medical and Surgical:—*Electro-Therapeutic Appliance*, A. W. Jackson, 431,978.

Miscellaneous:—*Electric Ceiling Block*, W. C. Bryant, 431,551. *System of Defending Harbors by Submarine Torpedoes*, A. G. Donnelly, 431,565. *Means for Moving and Guiding Turning, Engraving or Planing Tools*, G. M. Guerrant, 431,578. *Pneumatic Dispatch Tube*, S. F. Leake, 431,699. *Pneumatic Dispatch Tube Receiver*, S. F. Leake, 431,700 and 431,701. *Thermal Cut-Out*, L. B. Favor, 431,718. *Electric Device for Slaughtering Animals*, J. D. Miller and J. A. Doflemyre, 431,777. *Automatic Coin-Controlled Phonograph*, L. F. Douglass, 431,883. *Passenger Recorder*, A. Torrey, 432,008.

Railways and Appliances:—*Conduit for Electric Railways*, J. H. Wehrle, 431,633. *Electric Railway*, J. H. Wehrle, 431,631. *Signaling Apparatus*, J. H. McCartney, 431,671. *Trolley-Pole Supporting Mechanism*, J. M. Anderson, 431,684. *Electric Railway*, S. H. Short, 431,711. *Electric Railway*, R. M. Hunter, 431,720. *Electric-Railway Motor*, F. J. Sprague, 431,823. *Rail Support, Grip and Conductor*, W. S. Hull and J. C. Anderson, 431,846. *Hanger for Trolley Wires*, J. T. Henry, 431,973. *Electric Railway*, R. M. Hunter, 431,977.

Secondary Batteries:—*Apparatus for Preparing Electric Accumulator Plates*, C. F. Pollak, 431,617.

Telegraphs:—*Private Line Telegraphy*, P. B. Delany, 431,651. *Printing Telegraph*, G. B. Scott, 431,784. *Automatic Telegraphy*, F. Anderson, 431,793. *Automatic Telegraph*, F. Anderson, 431,794. *Printing Telegraph*, A. T. McCoy, 431,987.

Telephones and Appliances:—*Aural Attachment for Telephone Receivers*, E. C. Hess, 431,810. *Transfer-Connecting Apparatus for Multiple Switch-Boards*, E. M. Barton, 431,962.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

THE CLARK AUTOMATIC SAFETY DEVICE.

The Mayor and the Board of Aldermen of Newburgh visited the station of the Newburgh Electric Light & Power Co., recently, inspecting the operation of the Clark automatic safety device, manufactured by the Clark Electric Co., of the Corbin Building, this city. This is an automatic shut off that is intended to immediately cut off the current in the arc system in case of an accident by which the wire is broken or circuit interrupted. One of the great dangers at the present time in case a wire breaks is that the circuit may be completed by some adjacent object, and the current allowed to resume its operation. It is claimed that the safety device will immediately cut off the entire current of the circuit to which it may be applied. The appliance consists of a coil that is magnetized when the current is in action. The magnet then attracts and holds an armature, which, in its turn, holds a spring switch. When the current is cut off the magnet loses its power, the armature falls, the switch is then released, and springing back, cuts off the current from the dynamo. Thus it is claimed that if the weight of snow or ice upon a wire should break it, the device would cut off the supply at the station and all danger would disappear. The principle was applied in a practical manner by cutting a wire. The operation was perfect. The device cut off the current immediately and all the lamps connected with that circuit were at once extinguished. The device is the invention of Mr. Ernest P. Clark, the electrician of the Clark Electric Company. THE ELECTRICAL ENGINEER for April 30 gave a complete illustrated description of the device.

ROCHESTER'S NEW ELECTRIC RAILWAYS.

Work is now busily going on at Rochester, N. Y., in connection with the Short electric railway that is to be installed there. The equipment will include 50 miles of track and 100 new cars.

The power house, which is now in course of construction, will occupy all the space between the race, Mill street, Center street and the New York Central tracks. The site was purchased from the Central railroad company for $20,000. The power house will be of brick, two stories in height. Its smoke-stack will be 150 feet high, and its entire cost $60,000. This sum does not include the equipment nor the price paid the Central for the property. Besides the power plant, there will be located in the building a complete machine shop in which will be lathes, planers and all the machinery necessary for a fully equipped iron working shop. It will be the policy of the company to do its own repairing.

The power plant to be put in at the present time will consist of four Heine boilers, having a total capacity of 1,600 horse power; seven Ball compound condensing triple expansion engines, three of 300 horse power, three of 120 horse power and one of sixty horse power. The engines and boilers are being constructed by the Ball Engine Company, of Erie. The location of the power house was chosen with reference to the convenience with which coal can be dumped directly from the railroad cars into the company's bins. For the present use of the company there will be nine Brush dynamos of 120 horse power each, but the power house is built upon plans which anticipate the extension of the plant to nearly double its present capacity. The entire cost of building and plant cannot be less than $200,000—this, however, is only an estimate. The whole electric railway service will cost about $2,000,000.

MR. HAROLD BINNEY, M. E. E. E.

Having resigned his position as an assistant examiner, U. S. Patent Office, in class electricity, Mr. Harold Binney has taken up the profession of patent soliciting, etc., in this city, and has associated himself with Mr. Gilbert M. Plympton, a well-known patent practitioner and counselor at law. These gentlemen have their offices at 245 Broadway, and there carry on their business of obtaining patents for inventions and of attending to patent litigation in the courts. Mr. Binney, has of course, had special facilities in the electrical field, and some of his contributions to electrical literature will probably be familiar to our readers.

MR. W. J. HAMMER.

Few men are so well known in the electric lighting field as Mr. W. J. Hammer, who has just established himself as an electrical expert and consulting electrical engineer in the Temple Court Annex on Nassau street. Mr. Hammer did much of the pioneer Edison electric lighting work in this country, England and Germany, and enjoys not only the closest familiarity with electrical work in all its details but the widest possible acquaintance everywhere. It deserves mention also that he is possessed of unusual taste, as shown in his management of the great Edison exhibits at Cincinnati, and more especially at Paris last year, at the Centennial Exposition, where a comprehensive display was made of all of Mr. Edison's inventions. Mr. Hammer has in his office many interesting mementoes of that great Exposition, but what he most values is his unique collection of incandescent lamps. This collection, placed in cabinets so that the lamps may be easily examined, embraces some 400 or 500 specimens, from the very earliest to the latest. Mr. Hammer has been offered many thousand dollars for the collection, but refuses to part with it.

Mr. Hammer's specialties, the incandescent lamp detacher and his "electricians' pocket tool," are handled by The E. S. Greeley & Co., of this city. From some of his other inventions he also draws neat royalties. At present he is devoting himself entirely to engineering work, and his services have already been retained by a number of parties familiar with their value.

BISHOP CABLES IN NEW YORK HARBOR.

Mr. H. A. Reed, the secretary and manager of the Bishop Gutta Percha Company, 420–426 East 25th street, sends us the following interesting data:—

In the summer of 1887 we were requested to make specifications for a submarine cable with two conductors which should carry current from the light house station, Staten Island, six thousand feet under the waters of the bay, and light a fifty candle-power lamp on a buoy on Robbin's Reef; the current not to exceed 250 volts. We made the specifications (and afterwards made the cable) as follows: Strand three No. 16 B. & S. copper wires, insulate with gutta percha to a diameter equal to that of No. 1 wire, B. & S. Strand the two conductors with suitable laterals, serve with jute and armor with 18 No. 7 galvanized wires. The cable was laid in the fall of 1887, and worked so satisfactorily that similar cables were ordered and made by us the following summer for lighting the six buoys in Gedney's channel. As the current had to be carried about three miles for the channel buoys, we used more copper, viz.: Seven No. 18 B. & S., but about the same thickness of insulation (a trifle over 1-10" pure gutta percha). These cables have worked with Edison dynamo without interruption, except from marine accidents, to the present time.

About four months since Lieut. John Millis, under whose supervision these lights are, wrote me asking whether I thought the cables would carry an alternating current of 1,000 volts. In answer I told him I had no doubt that the cables would each stand 2,000 volts direct or 1,000 volts alternating, but advised him to first experiment with the Robbin's Reef cable, which was not now in use. I give the result in his own words:—

TOMPKINSVILLE, N. Y., June 30, 1890.

MR. HENRY A. REED, Secretary Bishop Gutta Percha Company, New York.

Dear Sir: It may interest you to learn that the experiment of sending an alternating current of 1,000 volts potential through the cable made by you for the electric lighted buoy off Robbin's Reef, New York harbor, proved an entire success. There was *no leakage* and *no injury* to the cable.

Respectfully yours,

JOHN MILLIS,
First Lieutenant of Engineers, U. S. Army.

DESTRUCTION OF INSULATORS AND WIRES BY COWBOYS.

Every telegraph wire on the Union Pacific Railway near Sydney, Neb., was interrupted on July 10, and all communication with the West and Pacific coast by this, the main route of the Western Union Telegraph Company, was completely severed from daylight until late in the afternoon.

A lot of cowboys who had been working on a round-up near Sydney visited that town at night, and, when they had exhausted all the pleasures of the metropolis of Cheyenne county, at daylight they mounted their ponies and proceeded a few miles west of the town, where they set up a target against a telegraph pole. They spent some time in hitting it from various distances, but, the mark proving too easy for their skill, they turned their attention to the insulators and wires, and only desisted when they had knocked off all the insulators and cut every wire with their bullets. The Western Union Telegraph Company sent repairers to the scene, but it took them all day to repair the damage.

THE NOVELTY ELECTRICAL SUPPLY MANUFACTURING CO.

All the arrangements have now been completed for the opening of the largest supply house in Cincinnati, under the auspices of the above well-known company, of 83 John street, that city. They now have over $100,000 worth of material in the way of electric light and electric railway supplies on the road to Cincinnati, and to arrive immediately, and they expect to have their new building ready in shape to do business by the 15th July. They have been very fortunate in the last few weeks in receiving large orders for their electric railway supplies, especially iron poles and pole tops, and may confidently count on a large and growing trade in their many meritorious novelties and specialties. Mr. E. P. Morris is the president and manager of the company and Mr. P. B. Chaney, secretary and treasurer.

THE BURTON ELECTRIC HEATER.

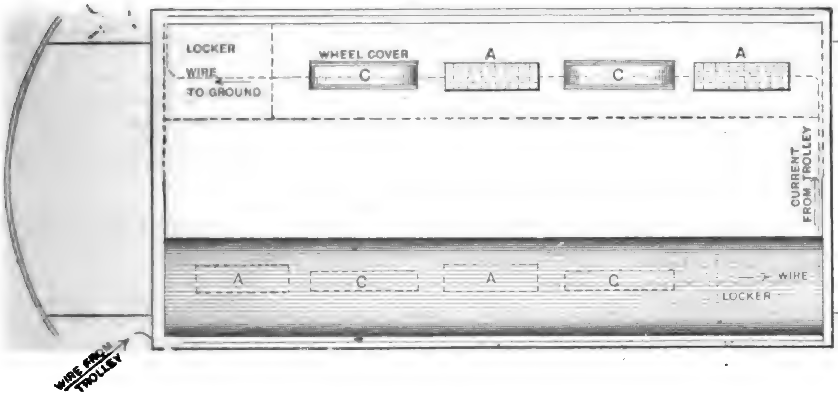
THE Burton electric heater has come to be recognized as an invaluable part of the equipment of an electric railway. It is manufactured by the Burton Electric Company, of Richmond, Va. For our illustrations we are indebted to the Electric Merchandise Co., 11 Adams street, Chicago, who are agents for the sale of the heaters. Fig. 3 shows two views of this heater. One represents it with the top on and ready for use, and the other with the top off, exposing the arrangement of the resistance wire on the inside. Before use this is covered with dry powdered fire clay and the top screwed down, care being taken to have the joints thoroughly packed to prevent the escape of the fire clay. The outer casing is of ordinary cast iron having a coating of asphalt or other varnish, and its dimensions must be such as will be suited to the space it is to occupy. In its adaptation to electric cars, it is made 27 inches long, eight inches wide, and is mounted on iron legs which raise it about four inches from the car floor. Fig. 1 is a ground plan of an electric car, showing the position of the heaters A, A, A, A. Fig. 2 is a cross section of the same, showing the heater under the seat resting on a tin or zinc reflector B, which throws the heat into the body of the car. Fig. 4 is a diagram showing the wiring of the heaters by which their efficiency is very much increased. By referring to this it will be seen that two switches, one line and two ground connections, are necessary to get the best results. The line connections should be made with the trolley wire which usually runs down in the corner of the car before it enters the motor switch on the platform. The ground connections should be made with the iron side bar on the motor truck, one on each side.

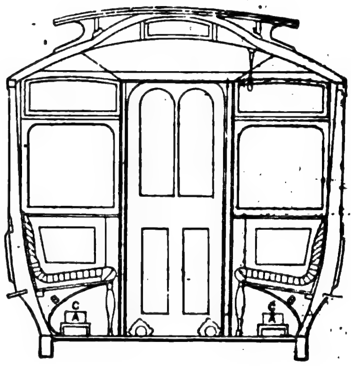
PEARCE & JONES.

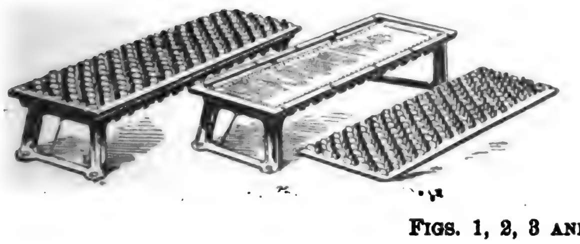
THE above named concern has been in existence for the last 18 years, and is therefore one of the oldest, as it certainly is one of the best known, in the business. The various products of the firm have long enjoyed an excellent reputation, and their skill as electrical mechanicians has often been called into requisition. It will be of general interest, therefore, to the electrical trade to learn that the firm have now dissolved partnership, Mr. James Jones retiring. Mr. Frederick Pearce, the remaining partner, succeeds to the business of the concern as manufacturing electricians, and will carry it on under his personal supervision at the old address, 77 and 79 John street, this city. Mr. Pearce will be happy to see the old friends of the business there, and will be glad to receive commissions from those who have not yet entrusted him with orders. He has the general good wishes for his success and prosperity under the new conditions.

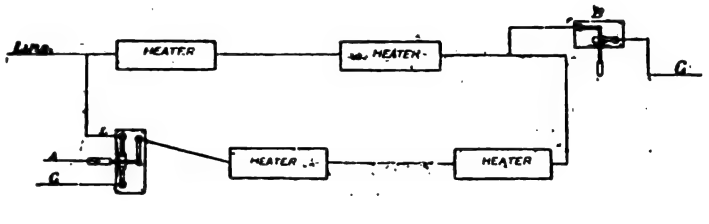
ARMINGTON & SIMS ENGINE CO.

The Armington & Sims Engine Co., Providence, R. I., have been enjoying a remarkably good business, and report that June was the best month they ever had. They have just issued a very tasteful and beautiful souvenir of Providence, that is highly prized by all recipients of it. Mr. G. C. Sims, who is one of the Rhode Island Commissioners for the World's Fair of 1893, has just returned home from the meeting of the National and State Commissions in Chicago.









FIGS. 1, 2, 3 AND 4.—THE BURTON ELECTRIC HEATER.

By this method of making these connections these heaters are entirely independent of the motors; and, besides, there could be no possibility of danger to workmen while oiling or repairing the motors.

For the special service of warming electric railway cars, the electrical resistance of the heaters is so regulated that on a 450 volt circuit, connected in series of four, they will use three amperes of current. When, therefore, the handle of the switch A is turned on L (shunt from line connection) and the switch B closed, the heaters are thrown in series of two for a short time only, causing the use of six amperes of current in each set. When a sufficiently high temperature has been attained in these—which will be in 15 or 20 minutes—the handle A is turned on G (ground connection) and the switch B opened. This causes them to be thrown in series of four, when the heat will be maintained in them for a long time without being appreciably lowered, with the use of only three amperes of current.

The electric railways which have been equipped with this device are emphatic in their praise of it. The committee on science and the arts, of the Franklin Institute, recommended the award of the Scott legacy prize to this heater.

Samples will be shown and prices given at the company's office, 11 Adams street, Chicago.

THE CROCKER-WHEELER MOTOR CO.

This young company moved into its West Fourteenth street factory only a few months ago, but has already increased its facilities, extending its floor area and putting in a number of new tools, etc. A large force is now busy turning out motors of the various sizes. The demand for fan motors during the past month has been phenomenal and it has been well nigh impossible to keep pace with them, in spite of every effort. The company has several special pieces of work in hand, and is much gratified at the manner in which its motors are being received by the electrical trade and the public generally.

THE CARD ELECTRIC MOTOR AND DYNAMO CO.

This progressive company of Cincinnati, O., has, at a recent meeting of the stockholders, decided to increase its capital so as to treble its present capacity. It has been compelled to cancel a number of orders owing to its inability to furnish the desired motors promptly. The factory at John and Front streets is in full blast, and the present capacity is sorely overtaxed. While the card motor is not yet generally known in the east, it has an excellent record in the middle and western states.

THE BAKER COMMON SENSE OIL FILTER.

Mr. F. A. Ross, the superintendent of the Livingston, Mont., Electric Light Co., wrote as follows a short time since to Mr. W. E. Crane, of 421 Thirteenth avenue, S. E., Minneapolis, relative to his filters: "Enclosed find exchange in payment of two 'Common Sense' oil filters, the last ordered by wire a few days since. I rather regret this last order, for I find that one filter will do all our work, and so well, that another is really unnecessary. I have had another make of filter in use, but in spite of all we could do, it would not return our oil as clear as we required it to be, and in consequence we had all the cans, pails, etc., we could muster filled with oil. I had not tested your filter for the amount of work it would do, as I wished to reserve it for the dynamos exclusively. I thought another was needed, if I wanted to keep engine oil separate. But such separation is unnecessary. Your filter seems to return all oil fed to it in an exceedingly pure condition. I have watched its action very carefully, and have taken many bottle samples, setting them aside for settlement and sediment; but have found nothing of the kind that the eye could detect. I must say, it is thoroughly 'common sense' in principle, and I congratulate you on having as neat and effective an article in hand."

ST. LOUIS TRADE NOTES.

The St. Louis Car Co. are busy with orders. Aside from their usual run of orders for cable and horse cars they are filling the following orders for electric cars: Thirty 24-foot summer cars, mounted on Thomson-Houston motor trucks, for Indianapolis, Ind.; twelve 16-foot closed cars, on Thomson-Houston motor trucks, for Peoria, Ills.; three 16-foot closed cars on Thomson-Houston 20 h. p. (single) motor trucks for Hannibal, Mo.; ten 24-foot summer cars mounted on Sprague motor trucks, for Los Angeles, Cal.; and five 18-foot cars, with Short motor trucks, for Muskegon, Mich.

The Laclede Car Co. have in hand the following orders for electric cars: 120 motor cars to be fitted with Sprague motors for the Minneapolis St. Railway Co.; fourteen 30 foot motor cars—Sprague motors—for Denver, Col.; eight cars, on Thomson-Houston motor trucks, for Streator, Ills.; twenty cars, on Thomson Houston motor trucks, for Duluth, Minn.; and eight cars—Westinghouse system—for Austin, Tex. They also have their usual share of orders for cable and horse cars.

NEW ENGLAND TRADE NOTES.

The Perkins' Electric Lamp Company, of Hartford, Conn., are having a remarkable demand for their incandescent lamps, and they have just completed arrangements by which they now can manufacture 5,000 lamps a day. Considering that little more than a year ago they were only making about 500 a day, it goes without saying that the Perkins' lamp must possess great merit, and is being pushed by an energetic and able management.

The Wainwright Manufacturing Company of Massachusetts have recently supplied the following heaters to electric light and power companies; Plymouth Electric Light Company, Plymouth, Mass., 250 h. p.; Schuyler Electric Light Company, Middletown, Conn., 150 h. p.; Stillwater Gas and Electric Light Company, Stillwater, Minn., 150 h. p.; Waltham Gas and Electric Company, Waltham, Mass., 300 h- p.; the Electric Light Department, City of Easton, Pa., 400 h. p.

The Wright Electric Engineering Company, of Boston, are at present making large extensions in outside construction work at East Weymouth. They will use about 135 poles and 12½ miles of wire. They have recently added 44 lights to the upper dining-room of the American House, Boston, and are installing 150 lights in the Surfside Hotel, Nantucket, Mass., which will be run on an alternating circuit from the Nantucket station, 2½ miles away. At Nantucket Beach the Wright Company are putting in an arc plant for illuminating the grounds of the Nantucket Hotel, Frank Ridlon & Co. furnishing the Brush dynamo. Besides a number of smaller jobs, they are also preparing complete station plans for Clinton, Mass., of 300 h. p., with an ultimate 600 h. p. capacity; and for the Derby Gas Company, Birmingham, Conn., who intend building a new station in which horizontal turbine wheels will be used geared direct to the countershaft.

The New England Electric Company have received an order from the Boston *Globe* for a 35 horse-power motor, to be used for running their "jumbo" printing press. The motor will sit in the pit with the press, and will gear direct on the shaft. It will be started and stopped and run at various speeds by the lever of the press. It will thus enable the press to run entirely independent of boilers and engines, and will always be in readiness to start up. The current will be taken from the two Edison circuits, both of which enter the *Globe* office, so that it can be run from either station. The New England Company are also in receipt of orders from the Edison Illuminating Company of Boston for a 10 and a 25 horse-power motor for elevator purposes in their new station, and a 10 h. p. motor for elevator in the Tufts College estate on Summer street. The contract for the increase and complete equipment on the Sprague system of the Naumkeag Street Railway Company has been closed this past week. The order provides for the change of the six 15 h. p. cars to six 30 h. p. cars, and thirty-five additional 30 h. p. cars, and the equipment of about 59 miles of track with the overhead system. The Naumkeag road was recently bought up by a strong syndicate, and the order comes from them.

WESTERN TRADE NOTES.

Mr. Charles G. Armstrong, manager of the house goods department of the Great Western Electric Supply Company, has gone on a business trip East, to purchase a general line of supplies. He will visit Boston, New York and Philadelphia, and perhaps some other points.

Mr. G. A. Edward Kohler, manager of the Chicago office of the Eddy Electric Manufacturing Company, of Windsor, Conn., with offices in the Rookery, has just sold two motors of 2 and 4 h. p., respectively, to the National Bank of Illinois, where they will be employed for ventilating purposes in connection with the Blackman ventilating fan.

Mr. W. H. Harding, the manager of the South Side Electric Company, is making rapid progress with his new station, at the corner of State and 20th streets. This station is equipped with the Ft. Wayne Electric Company's apparatus, Slattery induction system, and will start out with a capacity of 4,000 lights, the total capacity for which the station is at present designed being 10,000 lights.

Mr. Fritz Goldenzweig, an electrical and mechanical engineer, of Vienna, Austria, was a visitor at this office this week. He is investigating electrical matters in this country and has visited the large cities and proposes to spend a week or so in Chicago. Mr. Goldenzweiz is looking for anything good to take back with him to introduce across the water. He is stopping at the Palmer House and makes his headquarters at the office of The Electrical Engineer.

Mr. M. M. M. Slattery, the inventor of the induction system so named, which is manufactured by the Fort Wayne Electric Company, is in town for a few days, and is stopping at the Auditorium. Mr. Slattery speaks very encouragingly of the future, and has some good things in hand which he is working out, and when placed upon the market will show some novel and remarkable developments. His new alternating motors may be expected in the near future to be largely introduced, and of a new storage battery upon which he is working great things are promised.

The Great Western Electric Supply Company have just brought out a handsome little catalogue of their railway department supplies. It is merely intended as a preliminary to their catalogue, which will be ready shortly, but nevertheless contains some handsome cuts and much useful descriptive matter. It is devoted to street railway electric supplies, among which may be mentioned curve brackets, trolley line insulators, poles, span wire ratchets, gears, switches and car material, and forms a neat little book with quite a fund of information.

The Hazelton Tripod Boiler Company, 170 Twenty-second street, Chicago, report their well-known boilers to be in large demand. These boilers have given remarkable satisfaction wherever introduced. They have two large boilers of 500 horse-power each, in the street railway cable station, at State and Twentieth streets, the great success of which is shown in the emphatic statement made by the engineer and staff there that "they can't be beaten." The merits of these boilers will repay careful investigation by intending purchasers of steam boilers.

The Chicago Water Motor Company, 88 Lake street, Chicago, are introducing a new ceiling fan which is intended to be operated by electric motor, steam or water motor. They manufacture a special water motor for small powers for this kind of work. The same motors might be conveniently employed for small isolated plants, the motor driving a small dynamo. Their fans are very handsome and highly efficient. Central station men who are furnishing power for operating motors and fan outfits should look this matter up, as very favorable terms can be made by the company.

Bleckert & Nelson, successors to the well-known firm of Noyes Brothers, manufacturers of electric light, combination and gas fixtures, 85 and 87 Fifth avenue, are very busy making preparations for their heavy fall trade. They have installed a lot of new machinery and very largely increased the manufacturing facilities of the firm. They make a specialty of furnishing supply and construction companies with electric brackets and also manufacture electroliers and combination fixtures from special designs. They are turning out some very beautiful and tasteful work, and carry a large stock and very choice selection of goods.

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New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.
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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, *150 Broadway, New York city.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers*

VOL. X. NEW YORK, JULY 23, 1890. No. 116

The little that is known is a great and wonderful indication of that which is to be known.—Faraday.

ELECTRIC MOTOR VS. STEAM LOCOMOTIVE.

THE accurate data available as to the cost of operation, power consumed, etc., by electric street cars may be considered to furnish an adequate guide to the estimation of the similar items for electric motors of larger power intended to replace steam locomotives, such as those employed on the elevated railways of this city. We are, therefore, hardly prepared to accept the statements contained in a paper read by Mr. Lincoln Moss, at the recent meeting of the Society of Civil Engineers, in which he draws a comparison between the steam locomotive and the electric motor employed on the Ninth Avenue elevated road in this city. Mr. Moss determines that with good stationary engines, and with an efficiency of *fifteen per cent.* from the engine to the motor, the cost of one net horse-power hour by electricity would be $3\frac{1}{10}$ cents; while in the case of the steam locomotive the total cost per net horse-power hour is $1\frac{3}{10}$ cents; thus making the ratio 1 to $2\frac{38}{100}$ in favor of steam direct. The assumption of an efficiency of fifteen per cent. as a general figure from tests involving the operation of but a single experimental motor on the line is wildly absurd in the light of the results obtained in street railway work, where repeated tests have shown that 50 per cent. efficiency can be counted on, with the conditions far less favorable than those existing on the elevated railroads. This foolish, fallacious assumption is indeed quite on a par with many of the statements put forward by Mr. Moss to account for the losses. Thus we are gravely told that "the general economy and efficiency are greatest when a certain ratio of speed exists between the generator and motor armatures. Usually this ratio is as 2 to 1, the motor armature revolving but half as rapidly as the generator's armature." We are also seriously informed that in electric motors "the economy is greatest, other things being equal, *when the load is lightest.*" These puerile statements, we think, are sufficient to demonstrate that the conclusions arrived at by the author are apt to be, as they in fact are, entirely valueless; and we have only drawn attention to them as another example of the ignorance which unfortunately still exists among otherwise probably well-informed engineers regarding the action of the electric motor and the well-established data as to its practical economy. We are surprised that a body like the Civil Engineers should accept and listen to such a paper.

CHANGES BY THE SENATE IN THE McKINLEY TARIFF BILL.

AMONG the modifications made by the Senate in the provisions of the McKinley tariff bill, those touching copper and mica are of special interest to electrical manufacturers. The Senate Committee on Finance, in their report, greatly reduce the rates of duty on copper ores and on unmanufactured copper from those of the McKinley bill passed by the House of Representatives; while they keep mica on the free list, where it has always been and would remain but for the rise of economists of the McKinley variety.

As respects copper, the House bill cut the existing duties of $2\frac{1}{2}$ cents per pound on ores and 4 cents on plates, bars, ingots and pigs, just one-half; adopting the rates of $1\frac{1}{4}$ cents and 2 cents respectively. The Senate Committee proposes $\frac{1}{2}$ cent per lb. on copper ores and $1\frac{1}{4}$ cents on plates, bars, ingots and pigs. Neither House nor Senate proposes any changes in the existing high duties on manufactured copper, viz: 35 per cent. on rolled plates, sheets, rods, etc; and 45 per cent. on wire. We know of no arguments whatever for the retention of any duty on unmanufactured copper. The reasons against it are so obvious that good protectionists, like the New York *Tribune* and Congressman Butterworth, have been outspoken in denouncing it. But, even though no tariff bill pass both houses of the present Congress, the successive abatements proposed by the House bill and the Senate report make a record that will strengthen the hands of tariff reformers in future work.

Mica has always been on the free list. The owners of a few mica mines in North Carolina and New Hampshire, not making as much money as they would like out of their business, betook themselves to Washington last winter—as all producers of whatsoever commodities desiring more money for their products had been invited to do—and told a piteous tale of their necessities to the McKinley Committee. They wanted 50 cents to a dollar a pound duty put upon mica. They did not want an *ad valorem* rate: for, they said, nobody could tell what a ton of mica was worth till split and cut to sizes; importers would get the better of them by undervaluation. The committee, like the unjust judge under pressure of importunity, gave the mica men something—but something that neither they nor anybody else wanted—in the shape of a 35 per cent. *ad valorem* duty. This the Senate Committee has simply struck out, putting mica back on the free list.

Until eight or ten years ago stove manufacturers were

the chief consumers of mica, taking the greater portion of the product of the American mines, while no quantity worth mention was imported. The enormous growth of electrical manufactures during the past ten years has created a large demand for mica as an insulating material, and that demand is now chiefly supplied from India. The Indian mica has been found more suitable than the American for use in dynamos, because of its greater pliability, and the larger sized sheets obtainable from it; while it is less useful for stove doors, being clouded and more opaque. Under the electric demand the importation of Indian mica increased from a value of less than $1,000 in 1882 to $10,000 in 1883, and to $92,000 in 1889. From the figures given by the mica miners to the House Committee of Ways and Means, it appears that the American production has fallen off in value from $250,000 in 1882, $285,000 in 1883, $368,000 in 1884, to $161,000 in 1885, $70,000 in 1886 and $142,000 in 1887, while for 1888 and 1889 their estimates indicate a total of less than $100,000 for each year. During the past five years, it is alleged, mica has lessened in value 40 per cent. But assuming cheapness to be undesirable in mica—as Mr. Harrison assured us it was for coats and trousers—there is abundant evidence that the diminished quantity and lower price of the domestic production is mainly due to other causes than the importations from India. In consequence of the difficulty of getting an adequate supply of large sized sheets for stove doors (the chief commercial use of mica) and the dearness of such sheets, the stove makers divided their doors into a larger number of panels or panes, using two, four or more small sheets of mica in place of one large one. The difference in price per pound between small and large sheets is very great; prices given to the House Committee were 30 cents per pound for sheets 2″ x 2″ and $3.50 for sheets 6″ x 4″. Inasmuch as the Indian mica imported goes mostly to the electrical manufacturers, and but $92,000 worth was received in 1889, it is obvious that the mica miners are suffering less from foreign competition than from the effect of the business-like economy of the stove manufacturers.

PRESENT TENDENCIES IN DYNAMO AND MOTOR CONSTRUCTION.

The changes which have been brought about and are still going as a consequence of the introduction of the electric motor, afford a most interesting study, not only from the mechanical but from the social standpoint as well. The effect seen in the development of the steam engine alone would form an interesting chapter of history, leading to the irresistible conclusion that electric lighting and electric power have contributed more than any other influence to the perfection of the modern high speed engine. High speed was, indeed, necessitated by the construction of the dynamos and motors heretofore generally employed, in order, chiefly, to avoid as much as possible the use of counter-shafting. While the tendency to the reduction of speed in dynamos has made itself felt for some time past, it is but comparatively recently that this idea has gathered force with regard to electric motors. The reasons which have led to this new departure are, we think, not difficult to discern. It is, indeed, but the natural outcome of the endeavor to bring the speed of driver and driven shaft as nearly to uniformity as is possible, in order to avoid intermediate gearing, whether it be reducing or multiplying. The direction in which the tendency in question seems likely of accomplishment, practically, is in the employment of multipolar machines. The description which we give elsewhere of a motor designed to accomplish these objects shows that a very good slow speed machine has been made, so that the reproach, if such ever existed, that electric motor power meant high speeds, no longer holds true. What has just been said of electric motors applies equally well to the dynamo, the multipolar machine at reduced speed, such as that also illustrated on another page, finding a constantly increasing number of adherents.

The Western Union Fire.

Threatened more than once with a calamity of the kind, "195" succumbed to a big fire last Friday; and though the building was saved, the whole operating department, the battery room, and the Associated Press, were wiped out of existence. Fortunately no lives were lost. Had the fire broken out an hour or two later, the sadly inadequate means of access to the upper stories would have been responsible for wholesale slaughter. It is to be hoped that the damage done by the fire will cause many improvements to be carried out that have been delayed much too long. In the meantime, one cannot but congratulate the Western Union officials and the corps of operators on the energy and success with which they met the emergency and made the best of a very bad case. It was no common crisis, but it was faced with genuine courage, and matters were straightened out much sooner than one had any right to expect.

The New Unit "Henry."

Last week, the new unit "henry" was used for the first time, as a recognized addition to electrical nomenclature. Our readers will have noticed its appearance in the article by Mr. Steinmetz, and now Prof. Crocker extends us his congratulations upon this rapid passing into everyday use of the unit he has been urging for adoption. It will be recalled that at the Philadelphia conference in 1884, Mr. Preece had to make quite a vigorous fight for the "watt," and that one delegate, by way of complaint, deplored the early necessity of having to carry around a little pocket book, full of the names of the new units, as a remembrancer. But it cannot fairly be said that we have too many units. In reality more are wanted, and none will live unless they meet an actual necessity.

Electric Cabs.

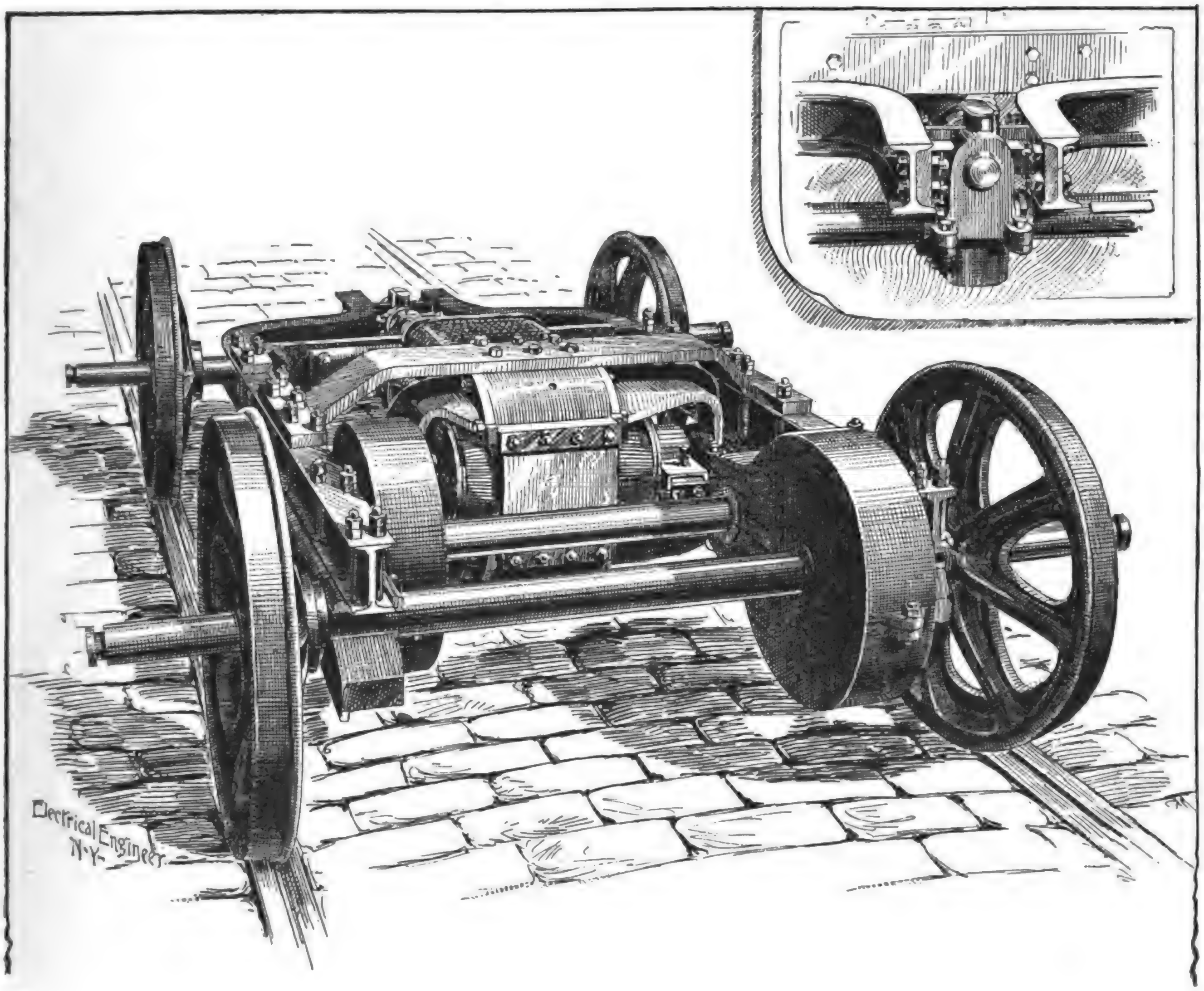
According to our Pittsburgh correspondent, the latest project there is an electric cab company, for which all the preliminary steps of organization have been taken. There seems to be more of politics than of practical science in the scheme, but no good reason can be found why electric cabs should not be run successfully where the streets are good. Our recollection of Pittsburgh is that its street paving is poor, not offering many opportunities for easy traction. However, the city is, it is said, to have no fewer than 40 electric cabs.

THE McDOUGALL ELECTRIC CAR.

For some time past Mr. W. M. McDougall, engineer of the McDougall Electric Company, of this city, has been at work on the construction of an electric street car, which is now rapidly nearing completion, and in which a number of novel ideas and improvements have been embodied by its designer, with the object of overcoming some of the difficulties heretofore met with in this class of work. The truck of the car, which is shown in the accompanying engraving, is provided with a motor of the single magnetic circuit type, the pole pieces, field cores and yoke being of mitis iron castings, and the armature of laminated sheet iron. There is no difficulty in obtaining an induction of 17,000 c. g. s. units per square centimetre in the field cores, when necessary, although the best induction for all-around economy is probably somewhat less.

The power is conveyed from the motor to one axle through a double spur gear transmission, the other axle not being used for propulsion. Mr. McDougall belongs to that school of engineers who contend that the only advantage of two motors under a car lies in the increased ability of the car to climb steep grades, while there is, he claims, a manifest disadvantage of the same nature as that encountered in hauling a train of cars with two steam locomotives hitched tandem. Again, gearing together rigidly the two axles of a street car, like the drivers of a steam locomotive, for the purpose of driving both from one motor, is, he claims, bad practice.

The motor car which is the subject of this article is intended for New York City, where experience has shown that one axle is sufficient for driving purposes. An inspection of the accompanying illustrations will show clearly that the McDougall motor suspension, while maintaining a perfect alignment between the armatur eshaft, counter-shaft and driving axle, in no way interferes with the flexibility of the running gear of the car. The motor is suspended by two bridges from two I beams of wrought iron. On the under side of these beams are a pair of combination boxes in which the counter-shaft and driving-axle revolve, thus maintaining the alignment and distances between centres, but allowing a slight end play. The other ends of the I beams are bent toward each other and bolted to a bronze casting, which forms one part of a universal joint; the other part of the joint, also of bronze, embraces the other axle, as shown in the vignette.



The McDougall Electric Car Truck.

This universal joint, besides the usual rotary motions, has an indefinite end play on the axle and a smaller end play on the longitudinal pin, so that the car gear has the requisite elements of flexibility, namely, a slight variability of wheel base, a perfectly independent and ample end play of axles, and a perfect freedom of the axles to depart from parallelism by motion in vertical planes. The yoke end of the motor is hinged to the bridge, so that the armature end may be swung down for removal when necessary. On the other hand, if it becomes necessary to change a field coil the yoke may be removed without disturbing the armature end. All bearings are self lubricating, and, it is calculated,

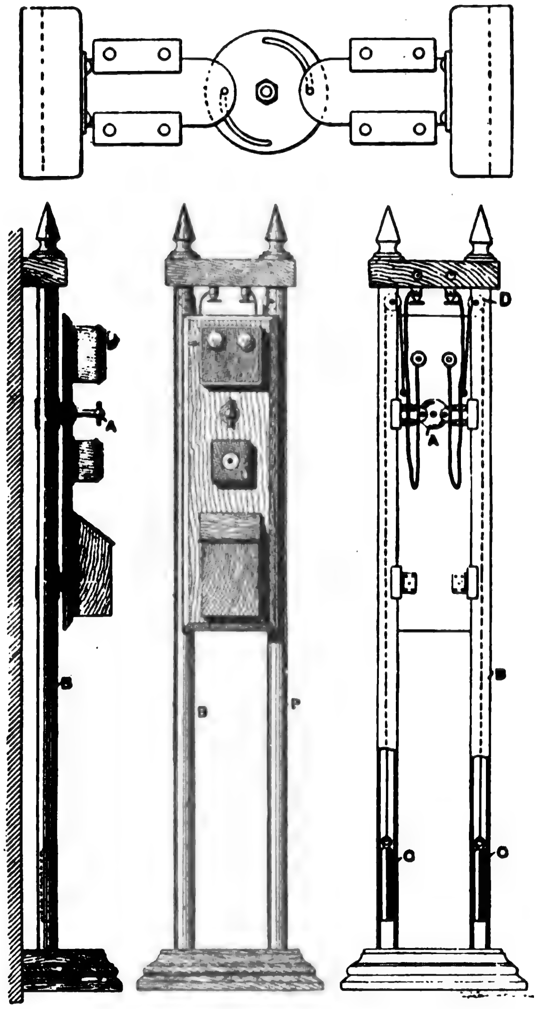
will require no more care than the ordinary street car journals.

The gears are incased in easily removable shells, which retain the lubricant and exclude the grit that so quickly ruins exposed gears.

The present car is built for storage batteries, but the McDougall Electric Company intend to build cars for the overhead system also, besides motors for stationary work. Mr. McDougall, we may add, has protected his suspension by patents, and the car will soon be put in practical operation in this city.

AN ADJUSTABLE TELEPHONE TRANSMITTER.[1]

A METHOD has recently been devised by Mr. J. C. Goulding, of Cardiff, for adapting telephone transmitters to the varying statures of the people who use them. The invention consists essentially in giving the connecting wires a considerable amount of play, and in mounting the transmitter, bell and battery upon a carriage which can travel vertically up and down upon guides. If desired, the range of motion may be made so great that the user may sit down during a lengthened communication; or, even further, the



FIGS. 1, 2, 3 AND 4.—ADJUSTABLE TELEPHONE TRANSMITTER.

guides might be made the whole height of the building, so that the telephone could be used by the occupants of the various floors. The arrangement of the apparatus will be easily understood by reference to the accompanying illustration, Fig. 1. The carriage which carries the transmitter is balanced by the weights, C, which are connected to cords; these cords pass down the hollow standards, B, and over the pulleys, D. The carriage may be clamped to the standards by means of the handle, A. Fig. 2 shows an enlarged view of the clamp. This apparatus is being made by Messrs. Woodhouse & Rawson, of London.

1. *Industries.*

BULL'S MAGNETIC BOILER INCRUSTATION PREVENTER.

IN a recent paper read by Mr. W. B. Bull, of Quincy, Ill., before the American Waterworks Association, he described the results of a series of experiments to obtain a method of overcoming scale in boilers by the use of magnetism. After trying various devices he finally adopted one in which the magnets are arranged within a cylinder in sheets and bundles. The latter form is shown in the accompanying engravings, Figs. 1 and 2. Here the magnets,

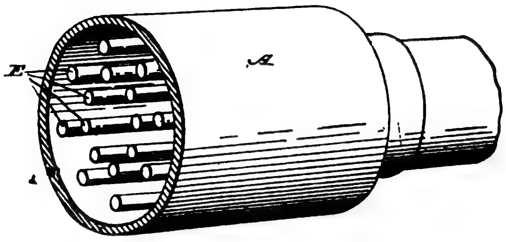


FIG. 1.—MAGNETIC BOILER INCRUSTATION PREVENTER.

E, are cylindrical in cross-section, and are so arranged that but very small spaces are left between any two magnetic points, the collective area or capacity, however, being made equal to, or greater than, that of the conduit on either side of the magnets, to prevent any retardation or permit the water to remain longer within the magnetic field. The cylindrical sheaf of magnets, it will be seen, is held in place by an open frame-work, E′, of non-magnetic material,

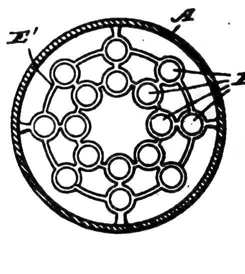
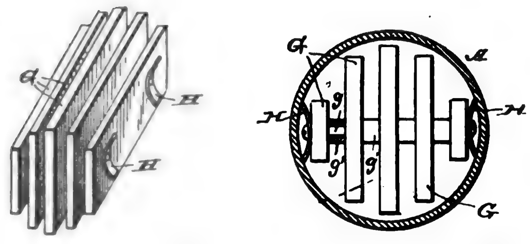


FIG. 2.—MAGNETIC BOILER INCRUSTATION PREVENTER.

and the whole sheaf and frames are so joined as that they may be readily removed in a body from the conduit.

A more economical and perhaps more convenient form of the device is illustrated in Figs. 3 and 4, wherein a series of prismatic magnets, G, is provided, joined together by bolts and intermediate washers, *g g′*. The magnets are properly proportioned and arranged, with the widest at the middle and gradually narrowing as they near the sides to fit within a tubular conduit or chamber, leaving a series of



FIGS. 3 AND 4.—MAGNETIC BOILER INCRUSTATION PREVENTER.

slits or flat openings for the passage of the water. This form of the sheaf or bundle of magnets is held in place by arms, H, secured in place by the bolts and resting against the sides of the conduit.

The magnets are made of plate bars of hard steel. In a cylinder 10 inches in diameter there are about 150 magnets made of ¼-inch steel, 1 inch in width, and of lengths varying from ¾ to 2¼ inches.

Mr. Bull also proposes to employ the same arrangement for the artificial "ageing" of liquors.

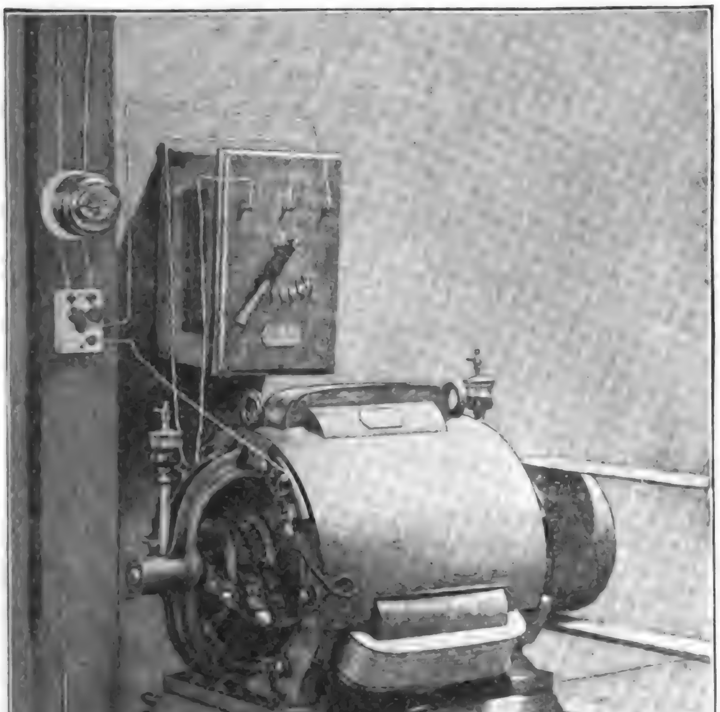
THE NEW PERRET SLOW SPEED MOTORS.

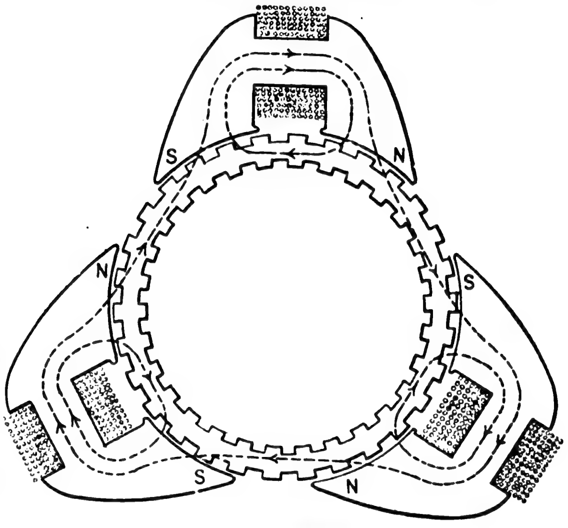
We bring to the notice of our readers, on this page, a departure in motor construction which has been effected by the Elektron Manufacturing Co., of Brooklyn, being the work of Mr. Frank A. Perret, the electrician of the company.

The new machines were brought out last year and have been giving great satisfaction wherever introduced, but a detailed description has not before been published, as it was desired first to test them thoroughly in actual work and to secure patents, which has now been done.

The new machines differ from the well known two-pole Perret motors in that they are of the multipolar type. This form has been adopted for all sizes above 2 h. p., and the company are now regularly manufacturing machines of 4, 6, 8, 10, 15 and 20 h. p., wound for 220 volts; and they are wound to order for any E. M. F. between 100 and 500 volts.

These machines mark a noteworthy advance in motor and dynamo construction, as they combine in one machine the important features of high efficiency, extremely low speed and close regulation without excessive weight and bulk. It is found in the electric motor field, as elsewhere,





Figs. 1, 2 and 3.—Perret Slow Speed Electric Motors.

that each make has its peculiarities; one excelling in this feature, another in that, and the manufacturers question if any one machine has ever before been put on the market which excelled in all of the three features mentioned. It is well known that most motors and dynamos are run at a high rate of speed, because the efficiency, regulation and output now demanded cannot be obtained at a low speed with the ordinary construction.

In the opinion of many of the best electrical and mechanical engineers this high speed is objectionable on various grounds, and not a few have during the past year recorded their belief that the next great advance would be in the line of a large reduction in speed. This belief has long been held by Mr. Perret, who has now carried it out in actual practice. That the improvement made by him is a radical one, is apparent from the simple statement that the revolutions of armature per minute in the ordinary shunt-wound Perret motors of the new type are between 500 and 600 in the sizes ranging from 4 to 20 h. p., which is less than half the usual speed, and for special work they may be wound to run at 350 revolutions or even less. It is of course understood that motors have been built that ran nearly as slow, but they were made expressly for some special work and were comparatively heavy, bulky and costly considering their power. It is thus a very different matter to put the low speed machines on the market at the same price as ordinary high speed.

It is not as fully understood by the general public as by builders and electricians that reducing the speed of a dynamo electric machine reduces the power or output accordingly, and that increasing the speed increases it. For example, a certain Perret motor, running at 600 revolutions per minute, develops 4 h. p. If it were wound suitably and run at 1,200 revolutions per minute, it would develop 8 h. p., and the price for an 8 h. p. machine could be obtained. In order to furnish a motor to develop 4 h. p. with the same speed as the Perret (600 revolutions), it would be necessary to use a machine which is now rated at 8 or 10 h. p. and which would either have to bring the price of an 8 h. p. machine or involve a loss.

The Elektron Manufacturing Co., therefore, claim that

in comparing prices, buyers should compare speeds also. The practical advantages of low speed machines are many. For instance, in ordinary machine shops, wood-working shops, printing offices, etc., the shafting is commonly run at 200 to 300 revolutions per minute, and it is a simple matter to belt direct to it from a motor running 500 to 600 revolutions, thus saving the first cost of a counter-shaft and one belt, and saving considerable power which would be lost in transmitting through the counter-shaft and additional belt used necessarily with a motor running at 1,000 to 1,500 revolutions. The same applies in the case of an elevator operated by belt; and in elevator work, indeed, it is possible to gear directly from the motor. The Perret machines have recently been applied by direct gearing to pumps and to coal-cutting machines in mines; also to the operation of coal-cutting machines by means of rope belt transmission from the motor to the cutter, and the company now have some very large orders for this class of work, which they claim would have been very difficult to meet with motors of high speed.

In addition to the advantages of low speed in the special cases mentioned, there is, of course, in all cases a general advantage in the avoidance of the rapid wear and deterioration usually connected with high speed. The machines are built with a 6-pole field and with armatures of large diameter, thus securing a powerful torque and great momentum of armature, which is a decided advantage when a heavy load is thrown on suddenly, as is often the case in elevator work and all kinds of hoisting.

It is quite remarkable that Mr. Perret has been able to retain in these larger machines the distinctive feature of laminated field magnets, for which his smaller machines are noted, and, indeed, the results secured would be well nigh impossible with any other construction.

In the accompanying illustrations Fig. 1 is a side view of a 20 h. p. motor complete with sliding base and starting-box. Fig. 2 is an end view of the same, and Fig. 3 is a diagram showing a cross section of the magnetic circuit.

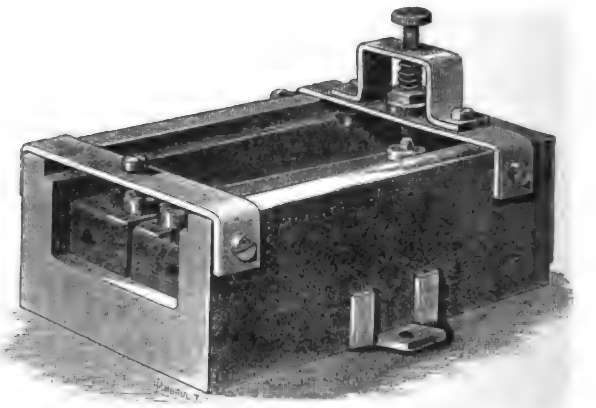
It will be seen that the armature is a ring of comparatively large diameter, with longitudinal channels on its periphery, in which the conductors are wound and thus embedded in the iron, which is in such close proximity to the iron pole-pieces that there is practically no gap in the magnetic circuit. The field consists of three separate magnets arranged at equal distances around the armature, each magnet having two pole pieces. The winding is such as to produce alternate north and south poles. The magnets are built up of plates of soft charcoal iron, which are shaped as shown in the diagram, and the magnet thus produced is of such form that it may be readily wound in a lathe. A non-magnetic bolt passes through a hole in each pole-piece, and the plates are clamped together between washers and nuts. These bolts also serve to attach the magnets to the two iron end frames, which are ring-shaped and are bolted to the bed plate of the machine.

The magnetic circuit is of unusually low resistance, by reason of its shape and shortness, which is shown by the diagram, and the superior quality of iron used. There is no magnetism whatever in the frame-bed or shaft of the machine, as the magnets are supported at some distance from the frame by means of the non-magnetic bolts, and the armature is mounted on the shaft by spiders of non-magnetic metal. There is, therefore, no opportunity for magnetic leakage, and, furthermore, the whole is enclosed by a shield or case of sheet metal as shown in Fig. 1. With such a construction it is not strange that the motors have won their reputation for high efficiency and close regulation as well as low speed.

The machines are calculated to be equally as efficient and desirable as dynamos, and are coming into use rapidly in small isolated incandescent light plants. For this purpose they are compound wound, and the regulation is so perfect that all but one lamp may be suddenly turned off without moving rheostat or brushes, and without noticeable change in the brilliancy of the remaining lamp. This severe test has been made repeatedly in the presence of electrical experts. Their low speed makes them well suited for direct connection to steam or gas engines, and they are specially adapted for lighting railway trains, yachts, steamboats, etc.

AN EXCESS CURRENT DETECTOR.[1]

In using secondary batteries it is well known that too heavy a rate of discharge may permanently damage the cells, and it is, therefore, important to have some method of calling the attention of the attendant when the current exceeds a certain value. With this object in view the Electrical Engineering Corporation, Limited, have produced the device which we illustrate on the present page, and may be described as follows: The body of the instrument is of slate, on which is mounted a V-shaped compound strip, composed of two metals soldered together in the same way as the strips used in Breguet's metallic thermometers and in certain forms of compensating pendulums. The current from the cells passes down one leg of



Excess Current Indicator.

the V and up the other, and, of course, heats up the compound strip; which, owing to the unequal expansion of its two metals, coils upwards, until, on the current reaching a certain value, its free end completes the circuit of an electric bell, thus warning the attendant that the current has become excessive. The device is ingenious and so simple that it would seem practically impossible for it to get out of order.

AN EASY RULE FOR CALCULATING APPROXIMATELY THE SELF-INDUCTION OF A COIL.

In a paper recently communicated to the Physical Society, Prof. John Perry gives a rule for calculating approximately the self induction which relates to hollow cylindrical coils, and is expressed by the following formula:—

$$\text{L (in secohms)} = \frac{n^2 a^2 \div 10^7}{1.844a + 3.1c + 3.5b}$$

where n = number of windings,
a = mean radius of winding in centimetres,
b = axial length,
c = radial depth of winding,

and b and c are less than $\frac{a}{2}$.

The time-constant of such a coil is given in terms of the volume of copper (V^1) in cubic centimetres by

$$\frac{L}{R} = \frac{V^1 \div 1{,}000}{728a + 1.33c + 1.5b},$$

and the conditions for making this small are pointed out in the paper.

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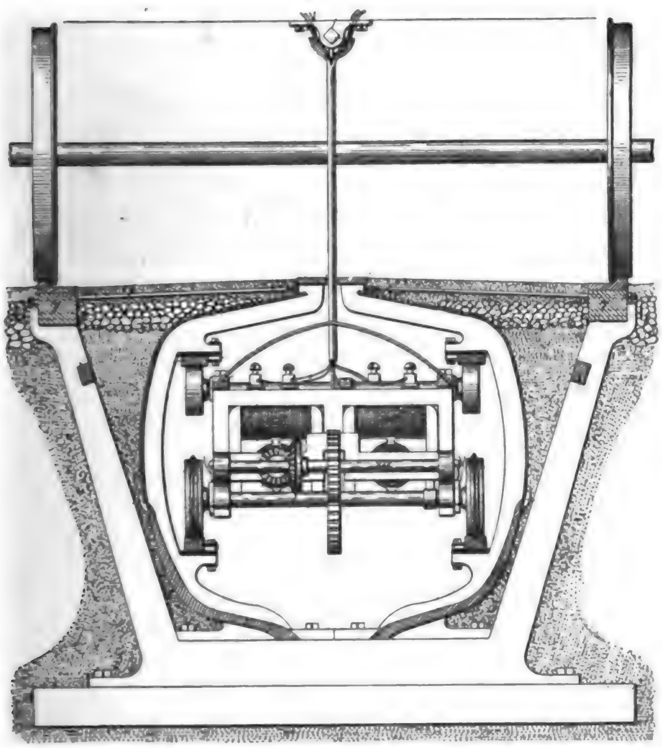
1 *Engineering.*

ACCUMULATORS WITH POROUS PARTITIONS.

In connection with M. Reynier's latest form of storage cell,[1] M. Chatiliez, manager of the Verdun water power electrical station, writes to *L'Electricien* to say that he has met with considerable success by employing ordinary porous partitions between the battery plates. These partitions are fluted to admit of the introduction of the electrolyte and pierced with holes to allow the liquid to circulate, and to diminish the internal resistance. The end plates rest against india-rubber washers. M. Chatiliez states that a series of experiments with these plates have shown that the grids may be made lighter and the perforations larger than usual without detriment. The internal resistance of the cells may be kept within moderate limits by slightly increasing the density of the solution.

McLAUGHLIN'S ELECTRIC RAILWAY CONDUIT SYSTEM.

Up to the present time electrical engineers have expended not a little time and ingenuity in methods for attaching the electric motor to the car truck, and in its connection to the driving axle, and have considered the



McLaughlin Electric Railway Conduit.

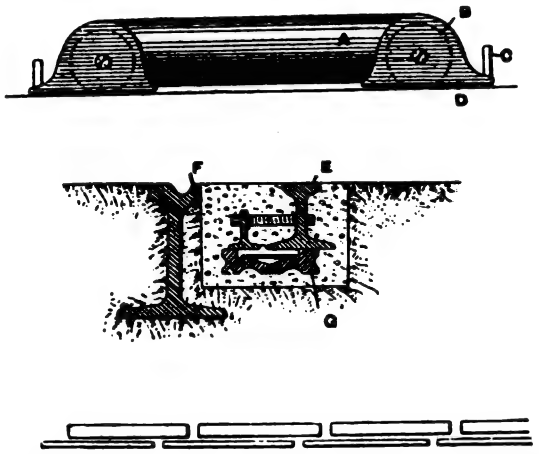
conduit method of conduction as a separate problem. It seems, however, that the field in this direction is by no means exhausted, as is evidenced by a system of electric railway operation and construction recently designed by Mr. James F. McLaughlin, of Philadelphia. It has just been patented. Broadly speaking, Mr. McLaughlin's system is one in which the electric motor itself travels within the conduit and is mechanically connected to the car which it drives on the surface, as distinguished from the motor carried by the car to be propelled.

The manner in which this idea is carried out is shown in the accompanying engraving. As will be seen, there is provided a conduit having two pairs of conductors, each of which constitutes tracks on which travel the wheels of a truck containing the electric motors, and these wheels are so arranged that they are forced into strong frictional contact with the conductor-tracks, so that good traction is obtained as well as good electrical contact. This motor-truck is connected with the surface-car to be driven by an arm extending upward through the slot usually provided in underground conduits for electric railways, and conductors connected to the motors are also carried to the car to be driven and connected to the switch under control of the driver. The motor-truck is also so connected to the car to be driven that the weight of the car is in a measure borne by the motor-truck, and the traction of the latter on the conductor-tracks is thereby increased, while provision is made for the slight vertical vibrations of the car to be driven when in motion.

THE LINEFF ELECTRICAL TRAMWAY.[1]

Some two and a half years ago a public trial of the Lineff Electrical Tramway was made at the depot of the West Metropolitan Tramway Company at Chiswick.

About eighty yards of line were laid, and a further portion, with turn-outs, was then being constructed. The system consisted of a conductor, well insulated throughout a large proportion of its length, mounted on brackets or chairs in a concrete conduit. At intervals of 3ft. 6in. iron crutches were provided as contact pieces, and a slack wire rope suspended beneath the car touched, and was dragged over, two or three of the crutches at a time. The attachments for the collecting rope passed through a slot in the roadway. For a low-pressure slot system the arrangement was excellent. The presence of the slot, however, was considered by the vestry authorities to be so objectionable that, as far as we are aware, the system was



Figs. 1, 2 and 3.—The Lineff Electric Railway System.

never put to practical use. Mr. Lineff has, therefore, worked out a new system, avoiding the use of the slot. He places his conductor in a conduit closed mechanically, but accessible, magnetically, through an iron covering. The conductor is laid in a small conduit, and contact is made by lifting a loose iron strip against the top of the conduit by means of a passing magnet. The magnet, A, Fig. 1, is provided at either end with a cast-iron wheel, B, making both electrical and magnetic contact with a smooth rail, laid in sections 3ft. long. The magnetic circuit is assisted by shoes, D, on each side of the wheels, having a clearance of about $\frac{1}{8}$in. from the rail.

Mr. Lineff provides a vertical brush, C, on the outer shoe at each end, to assist in collecting the current, as the iron wheels are of so small diameter that they would hardly make a contact of sufficient area with the rail.

The conduit is shown in section in Fig. 2, together with one of the tram rails. The I contact rail, E, in 3ft. lengths, is shown flush with the roadway. A smaller ⊥ rail, entirely buried beneath the surface, is mechanically and electrically connected to the I rail by yellow metal bolts, which insulate it magnetically. The lower flanges are

1. The Electrical Engineer, July 9, page 51.

1. *Industries.*

flush, and form the top of the conduit, which is constructed of asphalt, with earthenware insulators, one of which is shown at G, in section, in Fig. 2. Bare copper conductors are laid in two grooves in the insulator, and upon them lies a strip of galvanized sheet iron, about ⅛in. thick and 2¼in. wide. Both the conductors and the strip are shown black in Fig. 2. The whole is imbedded in a block of asphalt.

When the magnet which is carried underneath the car induces magnetism in the iron rails, a portion of the galvanized iron strip is picked up through a distance of about $\frac{5}{16}$in., and is held against the flanges of the rails, thus putting them in connection with the conductors. A passage is thus afforded to the current from the conductors, through the wheels on the magnet to the motor, and thence, as in most electrical tramways, through the car wheels, to the tram rails, and, to a certain extent, to the earth.

The magnet is said to require only 60 watts to hold up the iron strip, but 100 watts are employed in practice. The holding up of the strip does not strictly need any expenditure of power, but merely a certain number of ampere turns, involving a waste of power on the resistance of the copper exciting coils.

With a simple row of I rails, it was found, in preliminary experiments, that a very considerable excitation of the magnet was required, probably on account of end leakage. The introduction of the second, the buried rail, has overcome this difficulty, and in an ingenious way. The rails are arranged as shown in plan in Fig. 3, breaking joint with each other. The space between their flanges is small, and the area of the edges of the flanges opposed to each other is considerable. An easy path is afforded to the magnetic flux, zigzagging from one rail to the other. The inventor describes this as a number of magnetic stitches. The moving magnet undoubtedly does its work, and the car was handled with ease, and ran with no apparent sparking. A battery of some kind must be carried, in case a momentary break of the circuit were to allow the iron strip to drop. A hinged board is provided at either end, and on meeting an obstacle it yields and reverses the motor, at the same time setting the resistances to give a slow speed. An Immisch motor and Renold chain are used. A cleansing rubber keeps the contact rails clean, as any small stones would have a disastrous effect on the shoes, with their small clearance. As in the Wynne magnetic system, only those sections of the contact rail which are beneath the car form a part of the electric circuit, and are therefore out of reach.

THE NEW WENSTROM DYNAMO.

In a recent issue,[1] we illustrated diagrammatically the new Wenstrom dynamo, and we now take pleasure in showing the machine as it is built to-day, in perspective.

This machine is of the "iron-clad" type, and is shown in two views in the accompanying engravings, Figs. 1 and 2.

In general design it consists essentially of a cylindrical shaped body of cast iron, closed with heads or ends of the same material, and the whole, together with the bearings for the armature, resting on a bed-plate, forming a compact, easily constructed and simple piece of mechanism.

The armature, which is illustrated in Fig. 3, is so constructed that the iron of the armature comes as close to that of the field magnets as is permissible for free running. This is accomplished by threading the armature conductors through the iron a short distance below the periphery of the armature. In this way the resistance of the magnetic circuit is reduced to a minimum, the air space being almost entirely overcome, so that the current required to magnetize the field is correspondingly reduced. Again, the insertion of the wires within the iron completely protects them from injury during transportation and from all rough usage; and it also prevents their shifting during the operation of the machine, which sometimes leads to short circuits and consequent burn-outs. On account of the intense field possible by the reduction of the air gap the Wenstrom machines generate the required E. M. F. at a reduced peripheral speed.

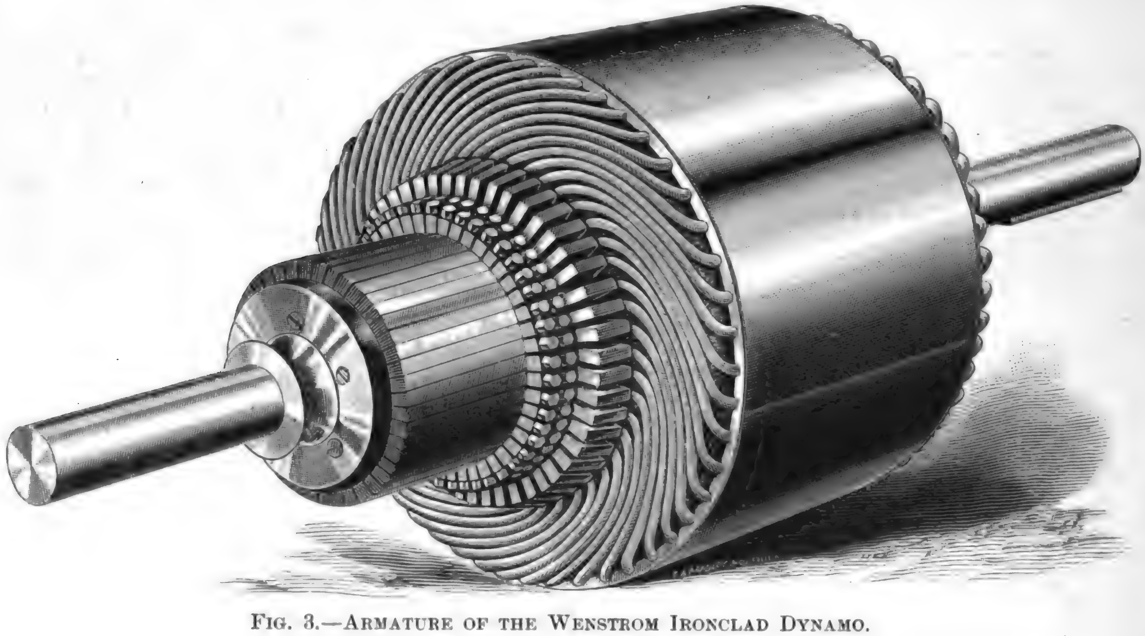


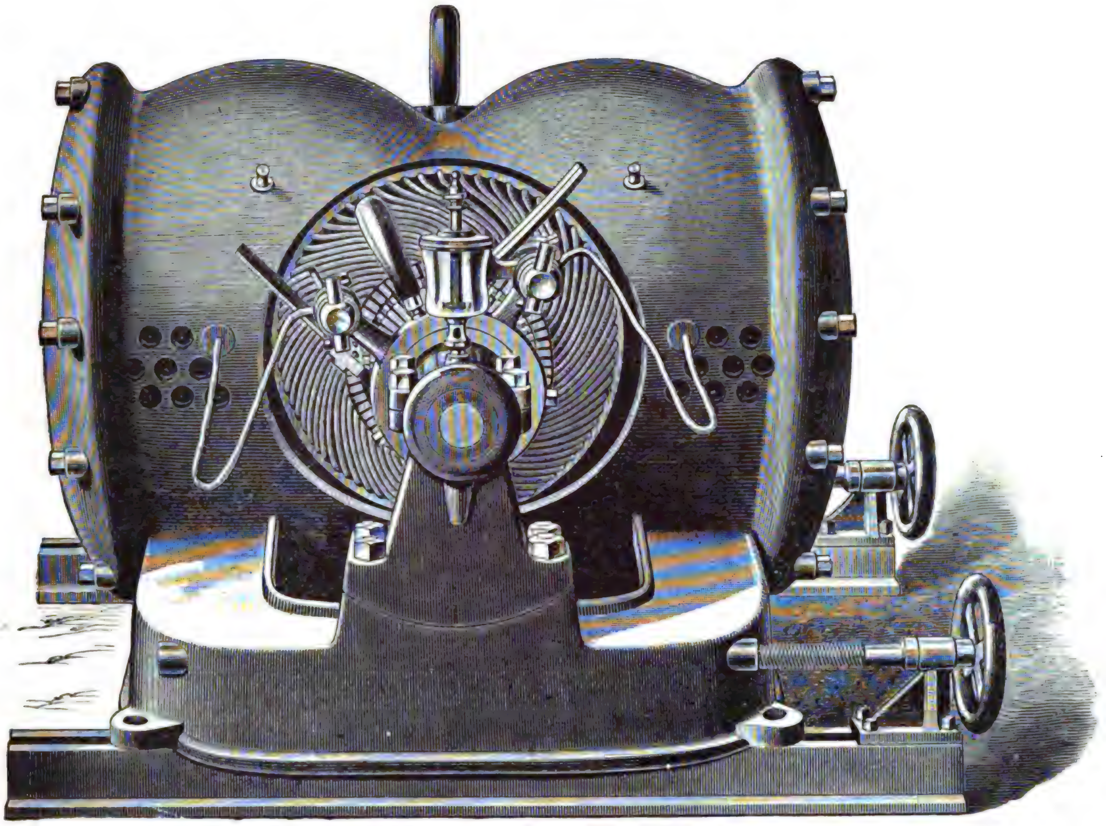
FIG. 3.—ARMATURE OF THE WENSTROM IRONCLAD DYNAMO.

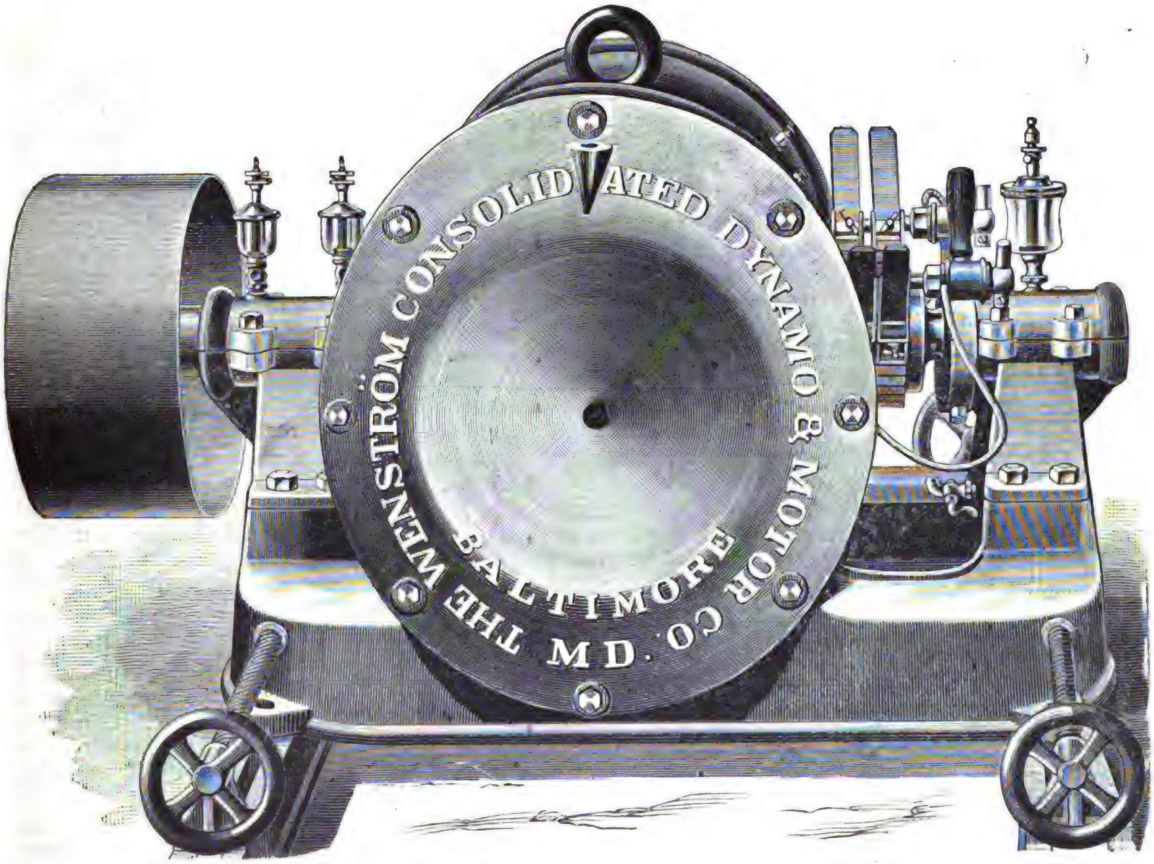
The motors manufactured by the company are of the same general design as the machine described above. They range in power from ½ to 100 h. p., and as they revolve at low speeds it obviates the use of considerable counter-shafting.

1. ELECTRICAL ENGINEER, June 11, 1890, page 455.

TESTING THE SIMS-EDISON TORPEDO.

A party of excursionists went to Willett's point, near this city, on July 15, to witness a trial of the Sims-Edison electric torpedo. Beside Mr. Warner Miller, there were present Everett Frazer, president of the Sims-Edison Electric Torpedo Company; W. Scott Sims, joint inventor of the torpedo; Capt. Ambrose Snow, Henry W. Munroe and Warren E. Hill. The torpedo, appropriately called a fish-torpedo from its shape, was started from a point about 200 yards from the dock, and ran in an almost circular course, at an estimated rate of 20 miles per hour. The charge consists of about 250 lbs. of dynamite. The company is now building for the government a larger torpedo, capable of carrying two miles of wire and 450 pounds of dynamite. The diameter of the boat will be 25 inches, and the length 33 feet.





FIGS. 1 AND 2.—THE WENSTROM IRON CLAD DYNAMO.

SHIP LIGHTING BY ELECTRICITY.—I.

BY W. H. FLEMING.

EIGHT years ago I crossed the Atlantic on a large and powerful mail boat, and what was considered a first-class, comfortable steamer. The saloons were then lighted by means of oil lamps, giving a poor light compared to what oil lamps can even now develop. The state rooms were lighted by candles, one candle placed in a receptacle in the division of each two rooms, so that it should do its duty of illuminating, as far as possible, both cabins; at 11 P. M. all lights were put out, and a solitary smoky lamp was hung up in the saloon to act as a night light.

Shortly after the introduction of lighting by electricity was proved to be not only feasible but practicable, an impetus was at once given to the lighting of steamers. The first transatlantic steamer to be thus lighted was the City of Berlin, of the Inman Steamship Company, but this was used only for the engine room and illuminating of the main saloon, and arc lamps were employed of the Siemens type. From that date forward, the progress of ship lighting by electricity has been marked and rapid, and to day, few steamers of any size, either passenger or freight boats, leave the builders' yards without a complete electric light plant installed on board.

The installations vary in capacity according to the passenger accomodations and the size of the steamer, from 50 lamps, to such as those installed on the City of Paris, and her sister ship, of 1,200 16 c. p. lamps. Great artistic skill has been displayed in the introduction of the electric fittings on board these magnificent Atlantic liners, and it is indeed a wonderful sight at night when afloat on one of these steamers, lighted from stem to stern and from engine room to pilot house. Since the dynamos are kept running continuously during the voyage, advantage has been taken of running motors for various purposes—fans for ventilating and cooling the state rooms and lower decks, motors for hoisting the ashes from the stoke-holes, and for many other purposes where they can be usefully and economically employed.

The Board of Trade have recently sanctioned the use of electric lights for the side lights and head lights. Two lamps, usually of 50 c. p. each, are placed in the lanterns formerly containing the oil lamps, and provided with automatic cut-outs, so that in the event of one incandescent lamp being extinguished, the other is immediately lighted. During the past summer, search lights of high candle-power have been installed on many large steamers, the object of these lamps being to detect ice and other obstacles during foggy or dark nights. They have proved of considerable use in lessening the dangers of ocean travel. Search lights is also employed in picking out buoys or entering channels or harbors at night time. It is only within the last two years that steamers have been permitted to navigate the Suez Canal after sundown. This is now accomplished by the aid of a powerful search light placed on a platform especially rigged for the purpose in front of the bows of the vessel, and about five feet above the water line. The whole outfit, including engine, dynamo, cable and lamps, is taken on at either Port Said or Suez, the two entrances to the canal, and after being used for this especial night travel are sent ashore. The charge for the use of this apparatus is moderate, and repays the owner of the vessel for the use of it, as the ship can then complete her voyage through the canal well within 24 hours.

The writer well remembers a passage through the canal occupying three days, though the distance is only 88 miles, owing to delays, and the then crowded condition of the canal. Vessels are not allowed to move at a higher rate of speed than five miles an hour, on account of the small width of the canal, and the wash of waves that otherwise would be caused by a vessel proceeding at a higher rate of speed, causing damage to the banks.

To ask any one even familiar with electric lighting on steamers, the number of incandescent lights that are burning every night on the north Atlantic, their answer would be considerably below the actual number. The total average number at the present time of 16 c. p. lamps lighted on this great fleet of ocean steamers numbers 100,000. This means machinery required to drive the dynamos of 10,000 h. p., and, taking a low average of six hours per day, when their full number of lights are on, requires a consumption of over 200 tons of coal per day, which would compare on land with a central lighting station of the first magnitude.

In many of the large ocean steamers duplicate sets of dynamos and engines are installed, to guard, as far as possible, against a total breakdown. To the engineer in charge, the adoption of electricity on board has proved of great service; any one who has had experience in examining the interior of the cylinders of boilers, will at once appreciate the advantage of a portable electric lamp over that of the ordinary "duck lamp," with its attendant smoke, smell, and its ready aptness to go out just at a critical moment of examining some particular seam or joint. Incandescent lamps, when protected with some suitable water-tight receptacles, have been used by divers for examining the propeller blades and stern post, and have thus saved the expense of docking the ship.

The prices at which installations can be placed vary considerably with the amount wished by the owners to be expended on the fittings. For the sake of an example it may be stated that a 100 light plant, including engine and dynamo, coupled direct, and supplied with the usual reading instruments, and wires run in molding, with all necessary cut-outs and switches, will cost, including lamps and sockets, but no fixtures, the sum of $2,700. This figure does not include steam and exhaust piping; the steam piping is taken not only from the main boilers, but the auxiliary or donkey boiler, so that the electric plant can be operated while the vessel is lying at her dock discharging and taking cargo.

The space occupied by this size of plant will be ten by three feet. The important points in the construction of the ship dynamo are as follows:

1. It should be direct driven. The reasons are obvious, as not only is the space taken up by the belting valuable, but in a sea-way the danger of running belts must be considered, and the possibility of accidents must be reduced to a minimum; it should be compact.

2. It should be free from liability to injury by salt water, and not too subject to mechanical damage.

On board ship salt water and damp air get everywhere, and within the last year a number of cases of slight burnout have occurred in armatures, which, when installed, measured high in the hundreds of thousands of ohms insulation. The dynamo should not be easily harmed. The dynamo room is now always low down in the ship, and when the light is not in use the room is very dark, rendering careful inspection difficult.

3. The dynamo should have small effect upon the compasses. This point has received little attention, though it is a matter of great importance, as the effect on many vessels is so large that, in order to work up the day's run, it is necessary to know the hours during which the dynamos have been in operation. Complete deviation tables are therefore necessary for the two cases. In different types of dynamos the effect with a twenty horse-power machine, at a distance of twelve feet, will vary from less than one-twentieth of the horizontal component of the earth's magnetism to several times the strength of the horizontal component. The latter is, unfortunately, rather the rule than the exception, and, in consequence, the position of the dynamo room has to be well borne in mind in locating the standard compass.

4. It should be easy in running and require but little attention. The machine should be non-sparking under constant load and also be able to stand sudden large changes of load with little sparking. This is necessitated by the

fact that the dynamos now supplied for incandescent lighting are also used for search light work, and the conditions are aggravated by most of the search lights having hand regulation only. Thus, with a 200 ampere machine, not only are from 50 to 100 amperes thrown suddenly on and off, but, at the moment that the operator at the projector brings the carbons together, the dynamo is suddenly called upon to deliver over three-fourths of its total capacity.

5. It should be efficient and run cool, the former in order to avoid the waste of energy and a corresponding amount of coal supply, and also in order to avoid over-heating. The dynamo rooms on ship board are, at best, warm, notwithstanding the motor fans, which are now usually supplied, and thus the safe limit of extra heating is reduced. At the same time consideration for the attendants requires that the cramped space be kept as cool as possible.

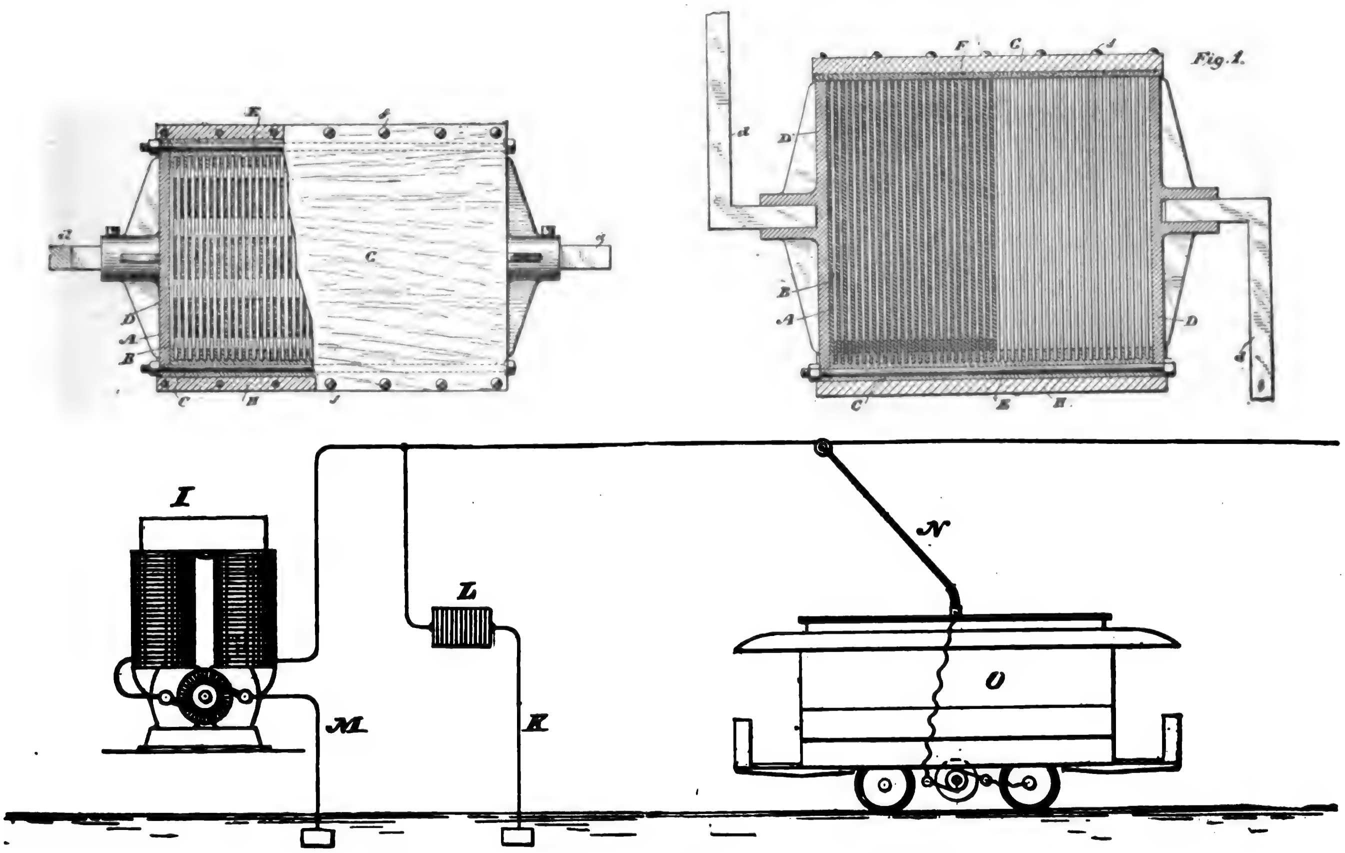
6. The dynamo should maintain a constant potential at all loads. This is, of course, accomplished by employing a compound-wound machine.

It is customary, where installations exceed three hundred lights, for the steamer to carry an extra man, rated as the electrician or junior engineer, whose duties are to take charge of the dynamos while they are running, and also to make such repairs as may be required from time to time. It is important, I think, to the owners, that the men so employed should in future, before having handed over to their care machinery of considerable value, be required to pass some examination, giving proof of their technical knowledge, the same as the men who are in charge of the main engines, and who are required to hold certain certificates. In many instances, had this rule been adopted, money would have been saved, as accidents have happened through sheer ignorance. I have known a case where the armature bearings have been allowed to heat, and instead of taking proper precaution to avoid or remedy this, a stream of water from a hose has been played on the bearings; in this particular instance the wiring of the ship was what is known as the single wire, or ship return. I leave it to the reader to imagine the result.

THE HOLCOMBE LIGHTNING PROTECTOR.

It was not long after electric lighting and power distribution had come into use that it was recognized that the methods employed to protect circuits from lightning, and which had, up to that time, been modeled upon those employed in the telegraph service, were inadequate. Damage from lightning was of frequent occurrence. It was clear that the introduction into the circuit of an apparatus which contained electro-magnetic coils created a self-induction which opposed more or less the passage of the lightning discharge and thus introduced an objectionable feature.

Various attempts have, therefore, been made to provide a lightning protector which should have no inductive resistance. The most recent work in this direction is embodied in the lightning protector designed by Mr. A. G. Holcombe, of Long Island City, N. Y., in which the object aimed at is to obtain a lightning protector, which, while always remaining in circuit and directly connected to



Figs. 1, 2 and 4.—The Holcombe Lightning Protector.

ground, shall have practically no resistance, and shall introduce no self-induction to oppose the passage of the discharge.

The anomalous statement that the arrester is permanently connected to the circuit and to the ground, and is practically of no resistance, may appear somewhat strange, but the manner in which Mr. Holcombe has effected this will be conceded to be highly ingenious. The principle embodied in the protector, briefly stated, consists in employing an apparatus having a potential of its own, equivalent to that of the line to be protected, and connected to the line in opposition, so that normally no current can pass through the protector.

This is carried out in practice in the apparatus shown in the accompanying illustrations, Figs. 1, 2 and 3, which show the protector in three different sections. It consists essentially of a series of lead plates, A, which are separated from one another by frames of blotting paper, B, dipped in paraffine so as to leave a small space between each succes-

sive plate. They are further maintained apart by narrow strips of paper, B. The whole is bolted together by end plates, D, and covered with a rubber sheet screwed down upon the top so as to enclose it completely.

By passing current through this arrangement the lead plates are slightly formed so as to develop a thin coating of per-oxide on one side of each plate and of sub-oxide on the other, constituting in fact a secondary cell. When this slight formation has been completed the sulphuric acid is removed and sulphate of zinc substituted to prevent any sulphating of the lead. With this solution the plates undergo no change, but the E. M. F. of the cells is raised to 2.5 volts.

The plates arranged in the manner shown and thoroughly inclosed are connected to the circuit in the manner illustrated in Fig. 4, which shows it applied to an electric railway system. It is evident that the positive terminal of the protector, L, is connected to the positive (+) side of the railway conductor system, and the negative (—) side of both the protector and the dynamo, M, are connected to earth. Thus with 200 plates in the protector, aggregating 500 volts, the same as that employed on the railway system, no current passes either into, or out of, the protector,

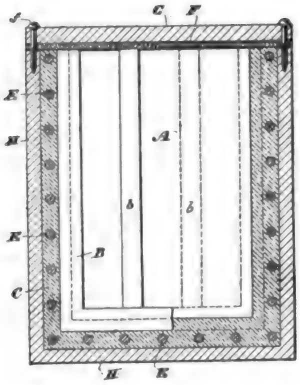


FIG. 3.—THE HOLCOMBE LIGHTNING POTECTOR.

as its potential is exactly counterbalanced by that of the line. But when the lightning discharge comes in over the line, instead of passing to earth through the dynamo having high self-induction, it passes directly through the protector, L, which, with the number of plates mentioned, has a resistance of less than one-fifth of an ohm and offers no self-induction whatever. This affords complete protection and saves the dynamo from injury.

On a system having a potential of only 220 volts only 88 plates would be necessary in the protector. These plates are about one foot square in area, and are composed of sheet lead as thin as it is possible to handle it, and for alternating currents Mr. Holcombe employs carbon plates instead of lead. The protector is evidently adapted for constant current circuits as well as for constant potential.

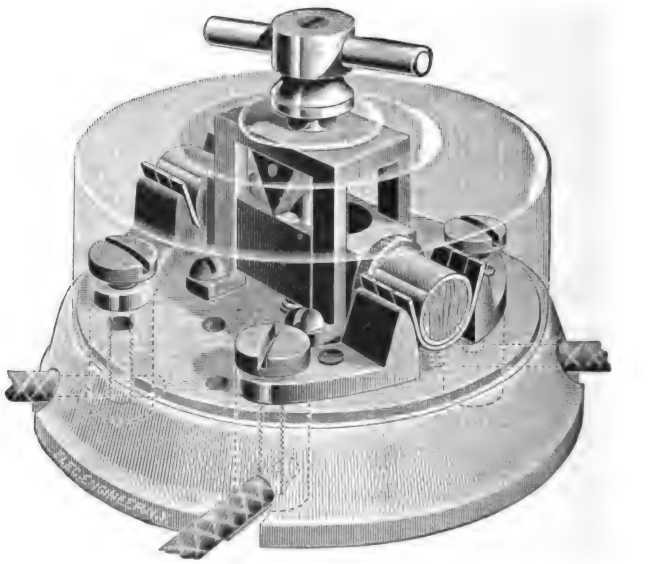
THE ROTATION OF THE PLANE OF POLARIZATION AS A MEASURE OF CURRENT.

IN 1851, Wiedemann discovered that if a tube containing bisulphide of carbon is surrounded with a wire carrying a current, the rotation of the plane of polarization is exactly proportional to the strength of the current. Starting from this point, M. d'Arsonval has devised a very simple arrangement for measuring currents and testing the accuracy of ammeters. In the apparatus recently shown to the Société de Physique, a coil of wire was wrapped round an ordinary saccharimeter tube containing pure water or bisulphide of carbon. The E. M. F. of a single Leclanché cell will cause a rotation of one degree. The apparatus can be made as sensitive as one pleases, since for a given current the sensibility depends simply upon the number of convolutions of the coil.

THE "NEW ENGLAND" SWITCH.

ONE of the most important details which go to ensure the success of an electric lighting plant are the switches for turning the lamps on or off. The requirements of a good switch are that it shall not only be able to carry the current safely without heating, but that it shall make and break quickly, so as to avoid sparking; and again that it shall be safe from grounds by being perfectly insulated.

These conditions have been well fulfilled in the "New England" switch recently brought out by the patentee, Mr. O. S. Platt, of Bridgeport, Conn., which is illustrated in the accompanying engraving. As will be seen, the



THE PLATT "NEW ENGLAND" SWITCH.

switch is operated by a handle to which a wedge-shaped piece is attached. By turning the handle the wedge is made alternately to press the brushes between the contact lugs, or to release them suddenly, by permitting a spring which has been compressed by the former operation to become free. The brushes are held firmly in place, not depending upon gravity or springs to hold them, but are firmly locked and can, as explained, only be liberated by turning the handle; when this is done the break is instantaneous, leaving no chance for the brushes to burn.

The brushes are perfectly insulated from every other part of the switch, being mounted at the ends of an insulating spindle which admits of the use of a metal handle not liable to become broken by abuse. The handle is held on to the spindle by means of one screw through the top, this one screw holding both the handle and cap in position.

The cap is of neat design, giving the switch an ornamental appearance, so that it is not necessary to put the switch in some inconvenient place for the sake of getting it out of sight. By removing the single screw the cap may be taken off at any time, even with the current on, with perfect safety.

Another very convenient feature of this switch is the manner of fastening the ends of the wires, which, as shown, are merely put straight into the slots in the porcelain base, and are held by one screw put down from the inside under the cap; the wire thus requires no bending or twisting, and hence also prevents the liability of a short circuit in connecting up.

THE BIDS FOR NEW YORK STREET LIGHTS.

Superintendent McCormack, of the Bureau of Lamps and Gas in the Department of Public Works, sent a report to Mayor Grant last week on his tabulation of the bids recently submitted by the various electric-light companies. He finds that the cost of lighting those parts of the city that are provided with electric-light lamps would, under the bids, be $77,678.65. The appropriation for that purpose amounts to but $71,507.29.

SOME DEFECTS IN PHYSICAL TERMINOLOGY.—II.

BY PROF. A. E. DOLBEAR.

Let it be admitted that a heated body sets up what we call undulations in the ether, that these waves have a wave length determined by the period of vibration of the atoms or molecules, and that the energy of the ether waves varies as the square of their amplitude, and let it be also admitted that there is not the slightest evidence that translational motion of a body of any size sets up waves in the ether, and it follows at once that what we call heat is the true vibration of the molecule and not its translational motion. That is to say, heat is the vibrational motion of atoms and molecules and its energy is proportional to the square of the amplidute of vibration.

If translational motion could impart to the ether any motion, of course a proportional part of energy would be observed by it, and the earth and other bodies moving in it would be slowing up. Now the velocity of the earth in its orbit is something like 17 miles a second, but the velocity of a molecule of hydrogen, the swiftest of molecules, at 0° C is but 1,843 metres, or only about $\frac{1}{16}$ that of the earth; so, if the earth movement sets up no waves, the free path of the gaseous molecule can much less. Again, the whole of spectroscopy teaches the same thing, namely, that the ether waves are set up by the internal vibrations of molecules and not by their external motions. As no other kind of motion is known that can produce similar effects, it would seem to follow that heat will be correctly defined when the character of the motions are specified.

When motion of one kind is transformed into another kind, the character of the energy is transformed also, and what a given amount of energy will do depends altogether upon its form, not upon its quantity; that is to say, vibratory energy has possibilities that do not belong to rotary or rectilinear. The vibratory motion of the piston of a steam engine must be transformed into rotary in order to advance the train, and if we named the vibratory motion of the piston x to distinguish it from other kinds, it would tend to nothing but confusion to speak of the rectilinear motion of the train as x motion, simply because it was the result of x motion; yet this is precisely what we do when heat is treated either as a translational motion, or as an undulatory motion in ether. There is the assumption that heat exists in three forms: I. The true vibration of the molecule; II., the translational free path motion, and III., the ether undulation when as both the translational motion and the ether waves are the *results* of the vibration of the molecule, the one by impact, the other by absorption; the one a transformation of vibrating into rectilinear free path motions, the other both a transformer and a transformation. To call each of these by the same name is to confound entirely different phenomena—an effect with a cause.

In every case where there is a so-called transformation of energy, what really happens is, a transformation of motion, hence if the various forms of motion have specific names the inconsistances will all disappear.

Third. It is but a short time ago that we were taught that there were three kinds of radiations from heated molecules—heat, light and actinic rays; but photography and the bolometer have rendered that statement quite untenable, for it has been discovered that what ether waves will do depends upon what they fall upon. One body will have its temperature raised, and we say it is heated; another body has its molecular structure broken up, and we say it has been chemically acted upon; and still another has a sensation incited, and we say it is the effect of light. Now that light is known to be a purely physiological phenomenon, and that there is no such thing apart from eyes; and even with the probability that what goes on in the eye itself is of the nature of photographic action, the general explanation of all the phenomena has been changed, but the terminology remains to mislead even those who are more or less familiar with the facts, as when one speaks of "the velocity of light," of the existence of "dark and light heat rays," and of the "temperature of space." If light be a physiological phenomenon, it cannot at the same time be an undulation in the ether; neither can dark and light be applied to the same phenomenon, nor can empty space have a temperature, as temperature is a condition of the molecules of matter. The term, radiant energy, has sometimes been used as a substitute for radiations, and in Daniell's "Physics" the whole range of undulatory motions in the ether is treated under the general head of Ether Waves. This is better than the other, yet between these two there is this discrepancy, that motions of any sort cannot properly be called energy, for, as said before, energy is a product and motion is but one of the factors.

Fourth. In the subject of electricity the lack of definitions in the terminology has led to a great deal of confused thought, but our actual knowledge of the character of electricity is much greater than many suppose it to be. Maxwell and others have asserted that whatever it may be it is not energy, while others, as represented by Preece in his late presidential address, assert that it is energy. Curiously enough Maxwell declares that it cannot be energy because electric energy is a *product* of electricity, E, into a current, C.

Edlund and some others have thought electricity to be identical with the ether, while still others have imagined it to be a fluid, or two fluids, or some kind of matter with the fundamental property of matter, namely, *mass*, left out. It is not very difficult now to see how such varied conceptions arose. An electrified body affects the space about it, or as we now say, it produces an electric field which is known to be a stress in the ether, and that implies a strain in the electrified body. It is also known that such stress is propagated in the ether with the common speed of ether waves, namely, 186,300 miles per second. The speed of this movement has been measured by so many and in so many ways that there is no doubt about it, and since the experiments of Hertz there is no room for doubt as to the existence of the ether.

What we now know is that states of stress in the ether are propagated at a definite rate in it, which rate depends not upon the source of the movement but upon the property of the ether to transmit movement; so, whether heat movements or electrical movements are antecedent makes no difference. We find no difference in perceiving the relation between the vibratory molecular motions and the resulting waves in the ether, but here is a precisely analogous case of electrified molecules and the ether propagating a motion, which implies, if anything, that molecular motion is the source of the ether displacements. One person will give chief attention to what is going on in the electrified matter, and another person to what is going on in the ether, and they come to different conclusions as to the nature of electricity, while a third person who notes their discrepant notions concludes that no one knows anything about it. What we call electricity originates in matter, and there is no evidence whatever that it ever originates apart from it. As Rowland has somewhere said: "It begins in matter and ends in matter." The conditions for its origination are differing and interfering molecular motions, whether in a thermopile, a galvanic battery or a dynamo; the conditions for its transference are a continuous material conductor, for it cannot traverse a vacuum. The effect upon the ether we call an inductive effect; and just as in heat phenomena we have a transference and a transformation, so is there also in electrical, both a transference and a transformation. In heat phenomena, where matter is placed in the *thermal field* so that the ether undulations fall upon it, the matter is heated. Likewise, when matter is placed in an electric field the matter is electrified. The cases are exactly analogous, and one is therefore justified in making the terminology appropriate to the phenomena; and whenever there has been a transformation in the motion, another name ought to be adopted and

not let the old one do double duty. If molecular motions of any kind be called electricity, then it is not proper to call any effects in the ether by that name. If the effects we study in the ether be called electricity, then do we need a name for what takes place in matter, for one is the effect of the other.

If one adopts the doctrine of the conservation of energy, and also that the matter of the earth is practically a constant quantity, it will lead him to conclude that all the varieties of energy are due to the various forms of motion that matter may have. If, also, one perceives that motion of any kind, at any place, implies antecedent motion, he will not feel the necessity for looking for hyperphysical explanations for any physical phenomena. For instance, when one sees the light and feels the heat from an electric arc lamp, knowing the nature of both the light and heat as being but particular forms of motion—one in matter, the other in the ether—he could logically look for nothing but some kind of motion that had been transformed to produce such effects. It is entirely immaterial what the character of the motions may be that produce electrical effects—that may remain to be determined by experiment—just as in the case of heat after the work of Sir Humphrey Davy and Count Rumford, it was then settled what the *nature* of heat was, namely, a molecular motion of some sort and not an entity. It is only within a few years that the character of the motion has been determined. In like manner we may say that we know what the *nature* of electricity is—that it is also molecular motion of some sort to be experimentally determined.

There are numerous reasons for thinking it to be a rotation as distinguished from a vibration. One of the chief of these comes from a study of electro-magnetic effects in the ether. It is generally agreed that this magnetic effect in the ether is of the nature of a whirl, or rotation, and in numerous treatises these whirls are pictured, but I do not remember to have noted that anyone has pointed out that a whirl in the ether implies a rotation of a molecule, for a similar reason that an undulation in the ether implies a vibration of the molecule. To me this appears to be necessary, but whether the motion be that or some more complex kind does not so much matter—it will be discovered in time.

Fifth. There is one more important matter I want to allude to and that is the expression first used by Maxwell, namely, "Light as an electro-magnetic phenomenon." Waiving for the time the criticism that light, being a physiological phenomenon, is therefore entirely inappropriate here, there still remains this fact that the ether waves from heated bodies move in straight lines, and unless deflected by the reflections and refractions of matter, will continue indefinitely on in the same straight line, making the *field of a heated body* as extensive as the universe; while the field of an electrified body depends upon the proximity of masses of matter, and practically is always limited in extent, and the observed lines are always curved. So if the two kinds of waves were really parts of the same movement, what is called a ray of light would seldom or never be found to move in a straight line for any considerable distance. If, on the other hand, the wave that originates in a vibration continues in a straight line only so long as it moves in homogeneous ether, and has its place of vibration changed by passing through a space of ether that has been electrically warped, as we experimentally discover to be the case, it would seem to follow that the two kinds of motion in the ether are fundamentally unlike. Either can exist without the other, and therefore they ought not to be called by the same name.

I have arranged the various elements concerned in physical phenomena into a table that presents at a glance the various motions involved in mechanical and molecular phenomena.

Elements of physical phenomena.
- Substance.
  - Ether—Simple. (Homogeneous).
  - Matter. (Heterogeneous.) Elements and their compounds.
- Motion. Rectilinear, Vibratory, Rotary and their compounds.
  - *In matter* called $Mv =$ momentum, $\frac{Mv}{2} \times v =$ energy.
    - *Mechanical*, if visible.
    - *Atomic* or *molecular*, if invisible.
      - External. Translation or free path.
      - Internal. Vibratory—Heat. Rotary?
  - *In ether.*
    - Rotary.......magnetism.
    - Undulatory.....ordinary light.
    - Spiral.......polarized light.
    - Vortical......matter?

THE PASSIVE STATE OF IRON AND STEEL.

In a paper on this subject recently read before the Royal Society, Mr. Thomas Andrews gives the results of his latest investigations in this direction. The results afford an indication that magnetization of comparatively low intensity, acting during considerable periods of time, exerts only a limited modifying influence on the passivity of iron or steel in the cold, though the influence is discernible when employing a delicate galvanometer. Magnetization, with the nitric acid at a higher temperature, produces a quicker effect. In a recent research by the author, on "Electro-Chemical Effects on Magnetizing Iron," it was noticed that local currents were set up between the polar terminals and central portions of steel magnets exposed as electrodes; and this class of local action, together with the slight alteration of the physical structure of the magnet bars consequent on their magnetization, may possibly be involved in producing the effects due to magnetism on passive steel or iron in concentrated nitric acid.

AN IMPROVED CONNECTION FOR CARBON BATTERY PLATES.

A USEFUL little improvement in the way of connecting the carbon plates of batteries has been devised by Mr. Dopping-Hepenstal, R. E. A small hole is drilled through the carbon plate about ¼in. from the upper edge. A piece of platinum wire, 24 or 22 S. W. G., is next snipped off obliquely, so as to form a chamfered end, and the last quarter of an inch or so of the piece is bent back upon itself, and pinched tight. The piece is then passed through the hole in the carbon plate, and pressed in hand tight, until arrested by the swell of the loop. A length of two to three inches will usually be found convenient. The plate may be partially or totally submerged in the exciting fluid. It does not matter whether the actual junction between carbon and platinum is above the level of the exciting liquid in the cell or below it, the platinum being, for all practical purposes, incorrodible. Thus a Leclanché cell can be sealed up, the carbon plate being entirely within the cell, and connected to the outside by a single platinum wire passing through the seal.

COMPLETION OF THE BERMUDA-HALIFAX CABLE.

Bermuda congratulated New York last week on the completion of the cable connection between that place and America. The mayors of St. George and Hamilton, Bermuda, sent a cable message to Mayor Grant. The mayor of Hamilton says that he hopes that connection with the Great America will cement the good feeling, increase commercial interests and prove in every way beneficial.

THE BREWER AND SMITH ELECTRIC VISUAL POLICE SIGNAL SYSTEM.

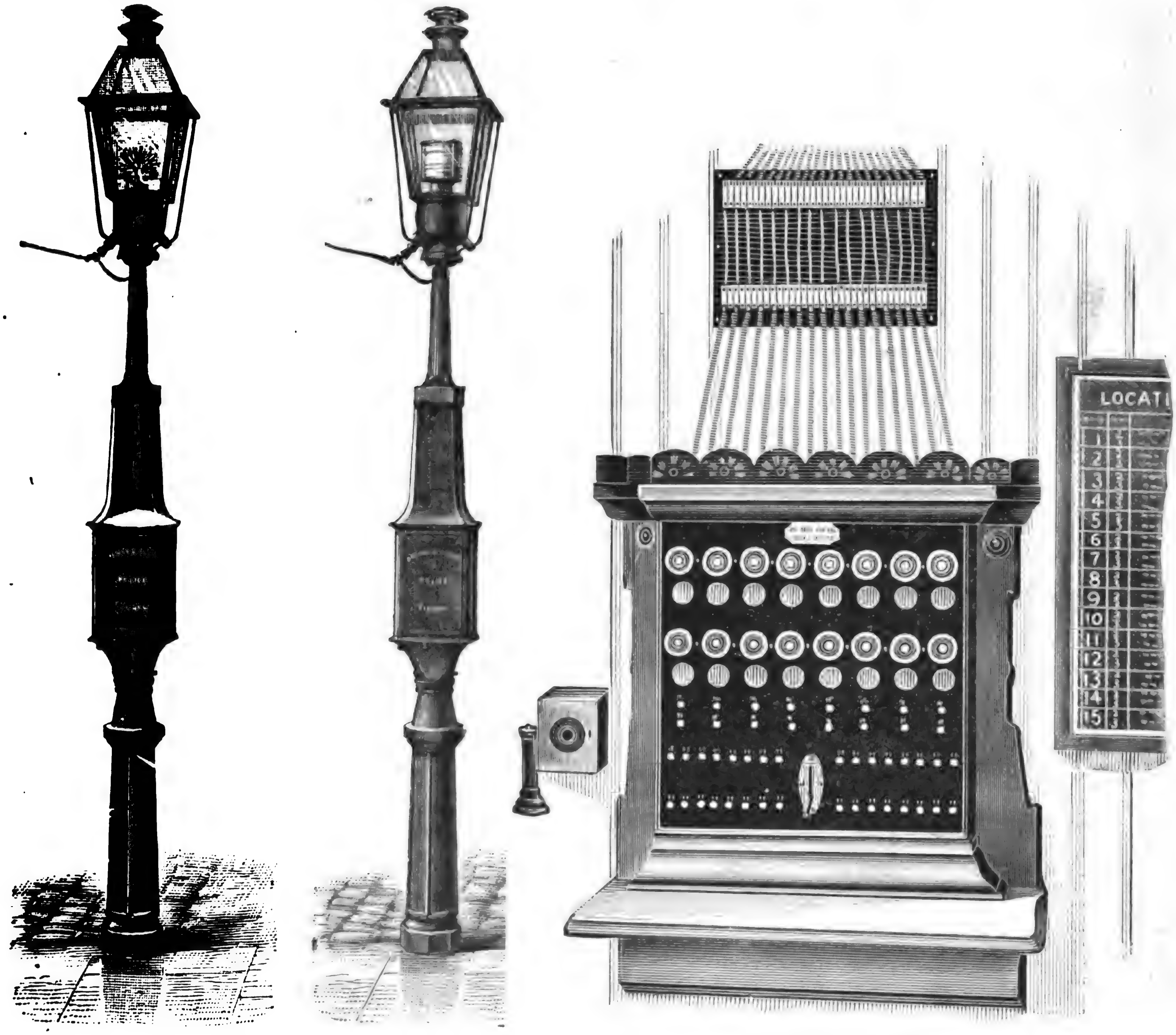
It has long been recognized that in large cities where policemen are frequently stationed at a distance from headquarters, some means of communication between them is necessary for a thorough protection of the city. A variety of systems designed for this purpose have been put into use in various cities, but almost invariably they have been of such a nature that while the officer on patrol could attract the attention of headquarters, the latter was unable to draw the attention of the officer on patrol, when at any distance from the signal box, especially at night.

To obviate this difficulty, therefore, Mr. James P. Brewer, of the New Haven, Conn., police force, and Mr. W. C. Smith, superintendent of the police and fire alarm telegraphs of that city, have designed what is known as the electric visual police signal system. It consists essentially of a visual signal united with the telegraph and telephone, which gives the officer at the desk the power to attract the attention of, and communicate with, any policeman, in any part of the city, no matter at what distance he may be.

The accompanying engraving, Fig. 1, represents one of the street stations, on the summit of which is an ordinary gas lantern or electric light, which, just the same as any gas lamp with its supporting post or electric lamp, furnishes light for the city streets. The engraving represents the visual signal as down or out of view, it being dropped below the light of the street station.

By the touch of an electric button at headquarters, an armature is released, and a red globe at once rises from inside the alarm box which encircles the gas or electric light as shown in Fig. 2. The change of color is seen by night on a street for a long distance, and in the daylight the colored signal can be seen for some blocks. The patrolman on his beat is thus notified that communication with headquarters is desired, and promptly responds through the telephone from the signal station to which the signal alarm has called him. After communicating, the colored glass globe is allowed to drop to its place of concealment. In the same manner as the central office can communicate with any patrolman on his beat, he can summon assistance from any adjoining beat, by opening the iron box, and, by a touch, releasing the armature which controls the ascent of the colored glass.

The box contains a complete set of signal, call, and telephone apparatus placed in a cast iron structure, simple and unique in design, forming no more of a street obstruction than the ordinary lamp post, and can be attached to any of the ordinary lamp posts in use in different cities. This



Figs. 2 and 4.—Brewer and Smith Electric Visual Police Signal System.

signal station is about eight feet in height, octagonal in shape, and of hollow construction ; midway it enlarges into a cast iron box sufficient in size to contain a telephone, transmitter, transmitter battery, calling and visual signaling apparatus, and the necessary lightning arresters and switches, all the apparatus being protected from damage by rain or snow. Inside and above the call box is an apparatus, with counter-balance weights, which holds in position the concealed red glass globe.

The engraving, Fig. 3, gives an interior view of the street signal station, the door being open. *a* shows a handle at one side of the interior of the street signal box. It is attached to a magnet which is used by policemen to signal to the central police office, making known there that the policeman wishes to communicate by telephone, or that he wants a patrol wagon or ambulance. By means of the button *b* the policeman can operate the visual signal mechanically, and when so used it will call help from neighboring beats and with perfect silence. *c* is a hook by which the policeman pulls down and retires the colored visual signal. There is a telephone inside of each street station, and a transmitter by which oral communication is effected.

FIG. 3.—THE BREWER AND SMITH POLICE SIGNAL.

The entire apparatus required at the central office is shown in the engraving, Fig. 4. It consists of annunciator drops, bells and push buttons, together with a telephone set. If a policeman on one of the lines or circuits makes a call, the annunciator drops and a bell rings. The number of rings shows by the code what is wanted. At the central office two lines can be connected, so that a policeman in one part of the city can send word to a policeman in another part, but as it passes through the central office it can be heard there by the officer in charge. The lower set of buttons seen in the cut, when pressed, raise the visual signal at any desired point in the city, and call the policeman desired.

It is evident that with a system of this kind the police force is raised to the highest standard of efficiency. Its operation in New Haven has been attended with the most satisfactory results, and we are informed that an installation of a dozen signal boxes is being set up in London by the police authorities there.

INFLUENCE OF MAGNETISM ON FLUORESCENCE.

BY PROF. A. E. DOLBEAR.

In the issue of THE ELECTRICAL ENGINEER for June 25, "J. J. J." asks for a publication of any experiments bearing upon the effects of strong magnets upon the phenomena of fluorescence or phosphoresence. The following experiment by myself may have some interest for him and perhaps for others.

I studied the effects of a strong magnetic field upon the phosphorescence phenomena in Crookes' tubes, of which I used several different kinds. The tube was charged by permitting sparks from a Holtz machine to fall upon one terminal. It was thus made to assume a sensitive state and could be removed several feet from the Holtz machine and the glow kept up while the machine was being turned. Under these conditions the tube was placed in a magnetic field produced by a strong electro-magnet, operated by a Morse key, and I found that the magnetic field could entirely control the luminous effects in the tube, being stopped entirely by the field of the magnet, and instantly restored by the electric field when the magnetic field was destroyed. So that the Crookes' tubes gave Morse signals where thus controlled.

Theoretical considerations led me to doubt the statement that the aurora borealis was due to electrical *currents* in the rare atmosphere in high latitudes, which has generally been the explanation given of the phenomenon ; and to test the effect of a magnetic field upon electrofied molecules the above experiments were tried. As the result of these experiments, I sent a paper to *Science*, which was published May 3, 1889. The experiments were not alluded to in that paper, because I considered there was nothing in them except what was easily deducible from what was already known.

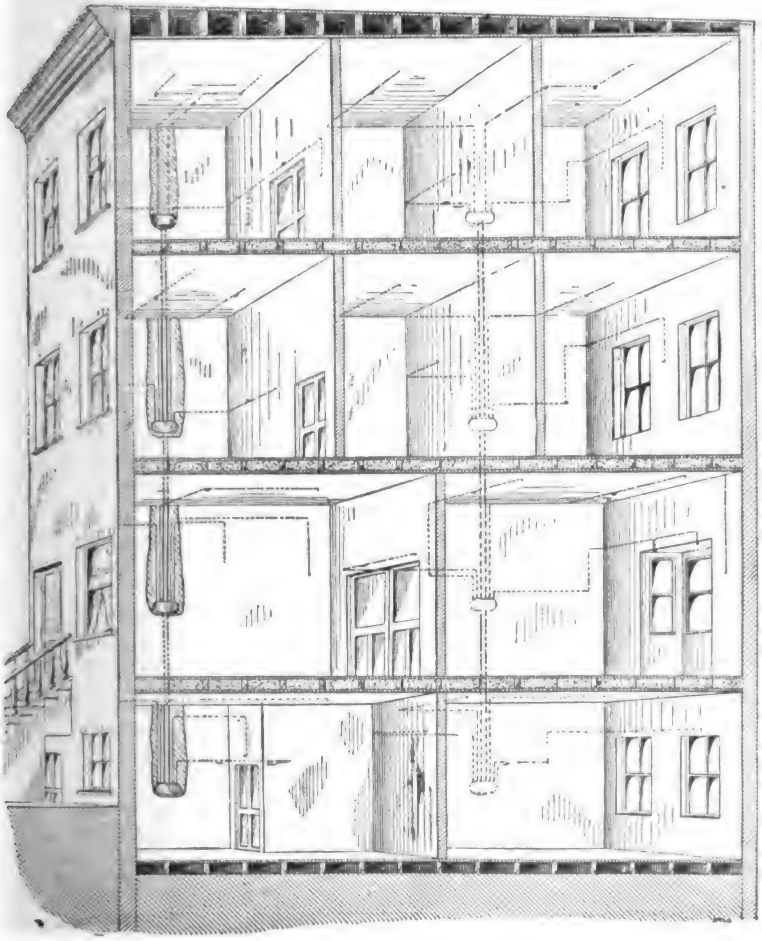
ACCUMULATORS AT THE BERLIN TELEGRAPH OFFICE.

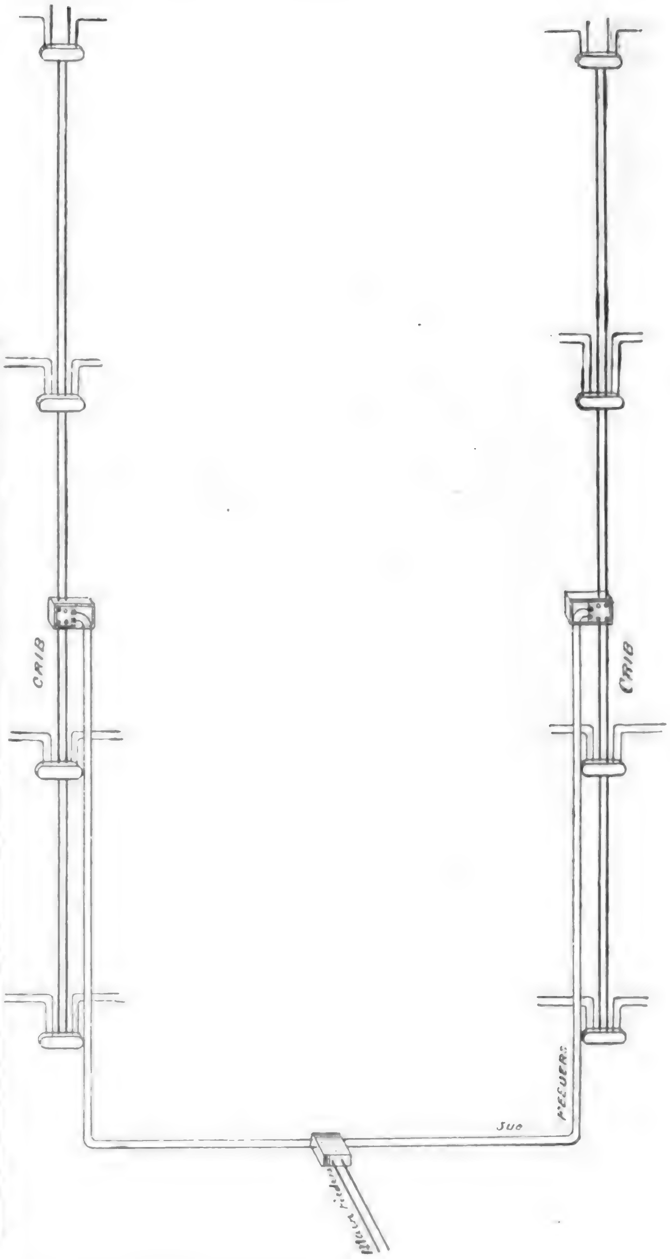
In a paper recently read before the Elektrotechnischer Verein, Herr Strecker, chief engineer to the German Imperial Telegraph Department, gave a brief account of the accumulators, which had been installed in Berlin in connection with the telegraph service. In October last a battery of 25 Tudor accumulators, having a capacity of 25 ampere hours, was installed at the Berlin telegraph offices. The cells are charged with a current of 7 amperes by a shunt-wound Siemens machine, driven by a 5 horse-power Otto engine. The current is conveyed to the central office, distant 1.7 kilometre, by means of a seven-wire cable, each wire having 5 ohms resistance. Only three wires are at present used, and they convey the current in the following manner : The first, starting from the eighteenth cell of the battery, supplies 36 circuits at 34 volts ; the second, starting from the twentieth cell, supplies 12 circuits at 40 volts ; the third starts from the last cell of the battery, and supplies 13 circuits at 50 volts, six circuits at 60 volts, and one circuit at 80 volts. In the two last circuits 10 and 30 primary cells respectively are added to the secondary cells. These 68 lines comprise 41 Morse and 27 Hughes circuits. The negative pole of the battery is connected to earth. The average discharge is at the rate of 60 milliamperes, so that the accumulators can supply this from 30 to 40 days, although, as a matter of fact, they are charged every ten days. The charging is effected in the following manner: The dynamo is switched on to the accumulators through a very high resistance, so that the charging current is at first very small indeed. A wire is taken from the centre of the battery to earth through a voltmeter, and when the E. M. F. rises by about 2 volts, the engineer in charge, by means of a switch, switches out a cell from the telegraph circuits, still leaving it in the charging circuits. The charging current is then increased, and as the E. M. F. rises still further more cells are switched out. The reverse process is gone through on stopping. The difference of potential on the telegraphic circuit during the charging operations is kept so uniform that no complaints have ever been received from the central office. Since the cells were first employed in the beginning of October, 1889, they have worked in an irreproachable manner, and the authorities are so satisfied with them that they now propose to adopt them on a far larger scale.

THE THOMSON-HOUSTON ELECTRIC CO. has organized a department for testing raw materials at the Lynn factories. It will be located in the basement of the new office building on Centre street. Felix Cleeverg, of the Sheffield Scientific School of Yale College, will perform chemical work in this department.

WIRING METHODS OF THE INTERIOR CONDUIT AND INSULATION CO.

One of the main features of the wiring system of the Interior Conduit and Insulation Co. is its employment of an insulating tube through which the conductors are carried, so that all the wiring of a house or public building lies in familiar, well-defined channels, and is at any moment accessible for inspection, extension or repair. Hitherto, wiring has been but too often a haphazard kind of work, so that its exact location was determined chiefly by the traces of its imperfection; and the effort of making changes and ameliorations has resulted in dismal disfigurement of walls and ceilings. The company have recently been preparing a catalogue and price-list for publication, and one of the illustrations shows the manner in which a house is wired up. We have reproduced this interesting cut in Fig. 1. In connection with this, another view, that in Fig. 2, is also important, bringing out as it does the "crib" system employed by the company. It has demonstrated by experience that electric light wiring can be done most economically and effectively by the establishment of centres of distribution wherefrom to radiate all minor branch circuits; and the system has been modeled in its entirety





Figs. 1 and 2.—Wiring Methods Employed with the "Interior Conduit" System.

upon this plan, by means of which really good work can be had. For mains and feeders the company advise a separate tube for each conductor, in which a rigid wire with either underwriters' or weather proof insulation may be employed, but for branches the special flexible twin conductor, with both conductors in one tube is resorted to. It is easily seen from the cut of the house that by employing as many "risers" as possible, long lateral runs, which are objectionable, are thereby avoided.

This system also has led to the invention of many new and useful appliances which greatly facilitate and reduce the expense of the installation of this admirable method of electric wiring, one for which none but words of praise and hearty recommendation are due.

The success met with by the Interior Conduit & Insulation Co's. system has borne out the estimate made of its utility. Not only are all the new buildings in the East, in course of construction, equipped with it, but it has also been specified by architects in other new buildings throughout the country, among which are the Board of Trade Building, Toronto; the Boston Building, Denver, Col.; the Bell Telephone Building, Boston, Mass.; New Jersey Central Depot, Seventh Ave. Music Hall, German Club, etc.

The fire last week in the Western Union building, could not, we believe, have occurred had the wires from the battery room to the switchboard been carried, individually, in the small tubes of the "interior conduit" system. It would have been practically impossible to start the fire by a short circuit or cross; and even had it started it could not have maintained itself. It is to be hoped that when the new switchboard is built, the wires from the battery room, instead of being massed together, as they were, in one big tangle, will ramify in a scientific manner through a system of tubes. The reform will be one of the best that the disaster presents an opportunity for.

CORRESPONDENCE.

PITTSBURGH.

Electric Railway Work—Tesla Motors—An Electric Cab Co.—The Allegheny City Plant.

The Duquesne Traction Company has just broken ground for the foundation of its new car stable, which is to cost $70,000. The structure will be two stories high with dimensions 165 by 400 feet. The excavations for the power house of the Birmingham Traction Company have been started at Carson and South Thirtieth Streets. This building will be erected at a cost of $15,000. Both of these roads are about to adopt electricity as the motive power on their lines.

The small motor of the Westinghouse Electric and Manufacturing Company is now being used on the vestibule trains of the Pennsylvania lines. The library car of the Chicago limited has been furnished with several of the motors attached to fans.

The Citizens' Traction Company held a few days ago a meeting and unanimously agreed upon an increase of the capital stock of the concern from two and a half to three million dollars. This increase is to be used for the purpose of extending the road from its present terminus to Sharpsburg, a distance of one mile. The financial statement submitted by the company for the first six months of the year shows their receipts to have been $288,061.92 and their expenses $199,617.57, making a net profit of $88,444.35.

It must not be forgotten that this road is a cable line and as the company is even at its present enormous expenditure earning an eight per cent. dividend, there is no telling the profits they would make should they adopt an electric motor system.

Pittsburgh is evidently determined that nobody shall outdo her in the development of rapid transit. The latest project about to be launched here now is the organization of an electric cab company. All preliminary arrangements for this plan seem to have been already concluded and the cabs are to be running as soon as possible. The cause for the introduction of this novelty however has been this: Ever since the Pleasant Valley electric line and the Second Avenue electric railway have been in operation and have demonstrated the great success of electric roads, the rush to obtain rapid transit franchises has been extraordinary. The result has been that there is scarcely a street in Pittsburgh and Allegheny to-day where it is not proposed to lay tracks and run electric cars. Of course in the race for obtaining council's permission, the favored parties and those with the best political influence got the best of their competitors who were less fortunate. It is in order to get even with the political favoritism that this cab company has been organized, because to run a cab along a street no special right of way is required. The cabs are to be modelled after the system which has been operated for some time in London and other European cities, the vehicles to be propelled by the storage battery method. The company intends to place 40 cabs on the streets to start with and increase this number as travel demands.

The new electric light plant of Allegheny City commenced operations last night for the first time and everything was pronounced a great success. The plant consists of 3,000 alternate current incandescent lamps and 500 arc lamps of the Westinghouse alternate current system.

PITTSBURGH, July 18, 1890.

BOSTON.

Annual Meeting of the Massachusetts Electric Lighting Association—Hospitality of the Officers of the S.S. "Minia"—Construction on the West End Street Railway—A Hint for a Safety Device in Open Cars.

THE first annual meeting of the Massachusetts Electric Lighting Association was held yesterday afternoon at Hotel Pines, Point of Pines. This association includes 30 of the leading local electric lighting companies in the state, representing a capital of $5,000,000, and 50 representatives of these various companies were present. The treasurer's and attorneys' reports were read, and the following officers elected for the ensuing year: President, Frederick A. Gilbert, of the Boston Electric Light Company: first vice-president, Hon. Theodore C. Bates, of the Worcester Electric Light Company; second vice-president, George W. Fifield, of the Lowell Electric Light Corporation; Executive Committee, Frederick A. Gilbert, Hon. Theodore C. Bates, George W. Fifield, C. L. Edgar of the Edison Illuminating Company of Boston, and C. A. Nichols of the United Electric Light Company, Springfield.

After passing a vote of thanks to President F. A. Gilbert for his able and efficient administration of the affairs of the association, the meeting adjourned to the dining hall, where a substantial repast was enjoyed.

The steamship "Minia" is attracting numbers of electrical men as it lies in Boston Harbor at present, and all are warm in their praises of the kindness of Captain Trott and his officers, who vie with each other in tendering true English hospitality to the visitor. The captain's "gig" leaves the wharf at the foot of State street every day at 1 o'clock, and daily there are small parties made up to go aboard and inspect the mysteries of the cable ship, and enjoy the pleasure of luncheon served up in true nautical fashion. There is an abundant supply of genuine English soda water on board, which, when mixed up under the eye of the genial captain, who generally manages to drop a cinder in it, composed of the "rale Glenlivet," has a most composing effect on the fagged brains of the weary shore-worker. Cool breezes and sparkling conversation on the deck "far from the madding crowd" tend to make a visit to the "Minia" extremely pleasant and not easily forgotten. Captain Trott's experience as a cable layer and cable repairer is unequaled, and now and then he can be induced to say something about it.

The West End Street Railway Company are taking every advantage of the fine weather to increase their tracks and overhead construction everywhere in and around Boston, and are now handling the immense crowds which visit Franklin Park nightly, with the utmost despatch. The tracks on Columbus avenue will be relaid this year, and work is now being carried on on Federal street, which involves the moving of the tracks of the Union Freight railway to the side of the street. Washington street is also receiving attention, and this line will soon be completed. Brighton, Everett, Cambridge and Somerville are also being thoroughly equipped, and heavy ⊥ rails being substituted for the light ones used by the horse cars. Electric railways are certainly a great attraction for the multitude, especially in the hot summer weather when open cars are in use, so that one can enjoy a long ride through the suburbs without witnessing the struggles of poor hard-worked, panting and overheated horses. Last week saw a fatal accident to a man who carelessly stepped off a car *on the wrong side* in front of an approaching electric car, and was instantly killed. During the past winter gates were put on all the closed cars on the side next the other track, just to prevent such accidents, as it is an easily observed fact that about 90 per cent. of people getting off cars will insist upon stepping off from the wrong side. Some arrangement for the open cars, apparently, could easily be made, and a wooden bar running the entire length of the car, it seems to me, would effectually prevent people, especially ladies, from stepping off in front of an approaching car. The writer well remembers seeing open cars used in Belgium with such a device, though there was a passage through the centre of the car, and with a car provided in this way it would be difficult for such an accident to recur. The bar could easily be changed from the one side of the car to the other at the end of the route, and its use would at least inspire the public with confidence in the company, and in the belief that all was being done that is possible to prevent accidents. A few would undoubtedly kick at first at the extra five seconds required in getting off and on, but they would soon get used to it, and sooner or later appreciate it, especially if they would only watch a few times as a car goes rushing past at about fifteen miles an hour and think how much chance they would have of escaping if they had stepped off unwittingly at that time.

BOSTON, July 19, 1890.

CHICAGO.

Objecting to a New Station—Examining Steam Engineers—The Smoke Nuisance—Prof. Gray for World's Fair Electrician.

A STRONG protest in the shape of an injunction bill has been filed in the Superior Court against the erection of the proposed new electric light plant of the Chicago Edison Company, at Nos. 2,638, 2,640 and 2,642 Wabash avenue. The plaintiffs are residents in the near vicinity of the proposed station. The dwellings of the plaintiffs, it is alleged, were erected with the idea that Wabash avenue was, and would remain, a quiet residence street away from noise and smoke of all kinds. It is charged that the Edison Company has excavated for foundations and is proceeding to build a large electric plant, whose furnaces will produce volumes of smoke, while the noise of the engines and dynamos will unfit the neighborhood for residence purposes.

The board of examining engineers, which is to examine and give certificates to all engineers before they can take charge of an engine, in pursuance of an ordinance passed by the Council last April, met at the office of the commissioner of public works this week and organized. S. F. Kerns was made president and E. C. Dicey, secretary. The other member of the committee is J. J. Keely. Mr. Dicey's salary is $1,500, and that of the other members $500 a year each—all to be paid out of the receipts from certificates, which will cost $2 each and be good for one year, when they can be renewed upon application and the payment of $2. The regular examining day will be Monday of each week. The board prepared a notice to be inserted in the newspapers announcing the provisions of the ordinance and fixing the first examination day for Monday, July 21. The board will meet twice each week, and the secretary will have a permanent office with the commissioner of public works.

The health department is stirring up the smoke nuisance offenders again and intends to begin a number of prosecutions. The department is investigating a number of new smoke consumers,

One of the most important questions now agitating Chicago is the smoke nuisance. The following described devices are some which are claimed to be highly effective: There are three devices used in this city which are quite effective smoke-consumers, or rather smoke-preventors. One of these is the Olson device, used in *The Tribune* building, by which steam sprays from coils of pipe on either side of the grate-bars are sent over the fire-bed at a suitable height. These sprays help to intensify the flame and prevent the generation of smoke. The device is simple and durable and its application is easy. Another device is the brick arch at the rear of the grate-bars and under the boiler. This is the device used so successfully by Gregsten, Field, and others in their furnaces. It causes a down draft, forcing the gases arising from the coal on the grate-bars to whirl down under the arch when the flame is strong and hot and thereby smoke is prevented from forming. This down draft principle is really the best that is easily available for coal smoke combustion. Another good device, and on the same principle, is the Ritter furnace, in which the arch is outside of the boiler. It is on this principle that the Boston complete combustion furnace is constructed, and it is an effective smoke preventive. So is the Murphy self-feeding furnace, but it is costly.

The name of Professor Elisha Gray has been mentioned for the office of electrical director of the World's Fair. Prof. Gray is a scientist in the highest sense of the word, and his name is known from one end of the country to the other, and scarcely less familiarly on the other side of the Atlantic. He is not merely a practical man, but something more—"a savant."

CHICAGO, July 18, 1890.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.
Anonymous communications cannot be noticed.
The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.
In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.
Sketches and drawings for illustrations should be on separate pieces of paper.
All communications should be addressed EDITOR OF THE ELECTRICAL ENGINEER, *150 Broadway, New York city.*

THE NEW UNIT "HENRY."

[130.]—I was very much interested to see that Mr. Chas. Steinmetz in his paper on the rectifying of alternating currents, contained in your issue of July 16th, made use of the name "henry" for the unit of self-induction. Although it is only a few weeks since I proposed this name, I believe it will not be very long before the term "henry" is in general use.

I can remember distinctly that it was hardly more than a year from the time the scientific journals began to use the terms "volt," "ohm" and "ampere," until these words were in everyday use among the common workmen in electrical factories and stations.

FRANCIS B. CROCKER.

AN ELECTRIC LAWN PARTY AND ELECTRIC FIREWORKS.

Mr. Edw. H. Johnson, the president of the Interior Conduit and Insulation Co., has a fine country residence, "Alta Crest," at Greenwich, Conn. His house is situated about four miles from the Sound, in the centre of a plot of ground of 33 acres, which, according to the United States geographical survey, occupies the highest point of land between Maine and Florida, a like distance from the coast. On account of the electric light and the electrical proclivities of its owner, the place has been very appropriately named "Electric Hill." The house itself is of the colonial style and from its spacious porticos a magnificent view on all sides is spread before the observer. The lighthouse off Bridgeport shoals is plainly visible 33 miles distant—such is the vista. The house stands on the apex of the hill and the broad-winding driveway which leads up to it by a circuitous route is lighted by numerous incandescent lamps on ornamental poles. An Edison plant supplies the light and power for the house as well as for the spacious stables and lawns.

Within the house itself Mr. Johnson has carried out many novel ideas in regard to lighting as applied to decorative effects as well as in regard to the useful application of electric power for household work.

In the groined, oaken hall, a large handsomely finished organ pours forth melodious music by the hour, by the simple manipulation of an ordinary electric switch. An apartment over the porte cochere, known as Mr. Johnson's "Den," contains trophies from all parts of the civilized and uncivilized world. An electric cigar lighter lies handy to an open box of cigars on a table. Two electric cooking stoves keep the late supper warm, while an electric teapot simmers on the sideboard and has been found convenient in supplying other warm decoctions besides the five o'clock cup. A huge horned owl blinks electrically, with large yellow eyes, from his perch in one corner across the room at a hideous bearded Chinese mask, which emits the red fire of passion from its open eyes, mouth and nostrils. Between the two is suspended in mid-air, a large specimen of porcupine fish, within whose transparent and bristling skin is concealed an incandescent lamp sufficient by itself to light the room. Electric fan motors cool the air when necessary. On one side of the room stands what may now be termed a relic—one of the first phonographs ever made, a monument to tin foil, lung power and muscle; while on the other stands the very last instrument, especially constructed for Mr. Johnson, at the phonograph works. The drawers of the cabinet contain a choice selection of musical cylinders which prove an endless source of entertainment to everyone.

On Saturday, the 12th inst., Mr. and Mrs. Johnson received some 300 guests at their annual lawn party, given in honor of the birthday of their daughter, Miss Edna Earle Johnson. For this occasion a large dancing platform 40 x 25 feet was erected on the lawn in front of the house, covered with crash and illuminated by strings of Chinese lanterns, each with an incandescent lamp within, suspended in festoons from decorated poles at the corners. Outside the house, the decorations consisted principally of artistic effects produced by an elaborate arrangement of incandescent lamps of all colors. Between each post of both the upper and lower porticos encircling three sides of the house were suspended flexible pendants bearing alternate colored lamps of red, white and blue, while from each of the third story windows hung lamps of like colors, and, surmounting it all, making one huge pyramid of light, was a varicolored cluster of lamps in the cupola.

From beneath the ivy which climbs thickly round about the stone tower containing the gun room and telephone room, peeped forth also many red and blue lamps. The flag-pole, seventy-five feet in height, floated the Stars and Stripes, surmounted, not by the conventional eagle, but by a pin wheel five feet in diameter, containing over a dozen red, white and blue lamps and rapidly revolved by an eighth horse-power motor.

By five o'clock the guests began to arrive and they soon scattered about the place. The bowling alley, billiard room and tennis courts were taxed to their utmost capacity, but the engine room, with its two Edison dynamos, storage batteries, engines, and various regulating apparatus, proved to be a place of endless entertainment and instruction. The pumps operated automatically by Sprague motors and forcing water from wells twelve hundred feet distant, as well as the electrical dampers and other heat regulating apparatus automatically and electrically operated were thoroughly inspected. The electric organ in the hall entertained great numbers, while the phonograph in the "Den" with its popular vocal and instrumental music was the centre of a delighted audience. The idea of lighting carriages by electricity, recently mentioned as new and just accomplished in England, has been in operation on Mr. Johnson's several carriages for a number of years, and was also illustrated. The feature of the evening, however, was a grand display of Paine's Manhattan Beach fireworks, which were ignited by electricity direct from the lighting circuit, a suggestion from Mr. Johnson, and something, we believe, never attempted before.

The fireworks, some one hundred and fifty yards from the house, were ignited from the piazza by the turning of a small electric switch in the hands of Mrs. E. W. Little. A tiny electric bell at her side gave the signal that all was ready; the switch was then pressed and the rockets and bombs exploded.

The modus operandi, as conceived and carried out by Mr. Johnson, was as follows:—For skyrockets a battery (not electric) was constructed of six pieces of the one-inch tubing of the Interior Conduit Insulation Co.'s underground tube—another new application for this useful article. Upon the upper ends of each tube, which were cut squarely, were driven two French nails about one inch apart, and one side of each set of nails connecting with copper wire to one pole of the circuit (taken from an adjacent lamp-post) and the other side of each set to the other pole. Each pair of nails were connected by the simple winding about with a piece of fuse wire of small capacity immediately under the touchpiece of each tubed rocket. Accordingly each fuse was thrown directly across the line and all in multiple on the moment the switch on the piazza was made to close the circuit through a flexible cord across the lawn, thus effecting the simultaneous explosion of the rockets. The bombs and other pieces were touched off in a like manner, to the delight of an admiring audience. As the evening drew to a close all seemed reluctant to depart from this veritable fairy land.

THE ARC IN THE TREATMENT OF ORES.

A special dispatch from St. Paul, of July 17, says:—C. A. Daigh, of the Westinghouse Electric Co., has been in Tower, Minn., at the iron mines, for the last week, experimenting with electricity and iron ore in the interest of his company. He declares that he has discovered a process by which he can centre the rays of an arc light upon a piece of iron ore and thereby soften it to such a degree as to be able to work it with a greatly reduced amount of labor. It has not as yet become known with what success his labors have met.

A DESTRUCTIVE FIRE AT "195."

A fire of large proportions broke out in the Western Union building at 195 Broadway, this city, on July 18. James Larrissey, a wireman, who was on duty in the building, was the first to discover the fire. About the same time Mr. Tobin, night chief, noticed an odor of burning rubber, and on looking into a wire shaft leading from the battery-room to the operating-room, saw smoke very distinctly. This was five minutes before 7 o'clock. When Mr. Tobin discovered the smoke in the shaft and descended to the battery-room he was surprised at the great headway the fire had already made. The flames followed the wires to the room behind the great switch-board, and soon all the woodwork was burning. The fire leaped from table to table and to the window and door casings, and all efforts of the men on duty to suppress the burning by the appliances at hand were unavailing. The firemen were promptly on hand, and took possession of the building. The day force of operators were reporting for duty, but found it necessary to retire, and gathered in waiting at the Telegraph Club in Cortlandt street. Five female operators were led out of the building by the firemen. Some of the women in the restaurant were rescued from the roof by firemen of the life saving brigade. All above the sixth floor was destroyed. Carpets, papers, etc., on the fifth and other floors below, were soaked with water. The battery and storage rooms occupied the sixth floor.

The operating-room and the gallery devoted to the work of the Gold and Stock Company occupied the entire seventh floor, and the Associated Press and a part of the bookkeeping the entire eighth floor. On the ninth floor were the Western Union files.

The loss of the telegraph company is very large, and it will require a long time to replace the material. The large switchboard in the operating-room alone cost $50,000. The Associated Press lost instruments, typewriters, furniture, and all of its books, papers, and records dating from 1845, and a valuable refence library. This loss is irreparable. All of the material for a history of the growth of the press in America, contained in letterbooks and files, was destroyed and can never be replaced. The money value is estimated at $15,000. There is no insurance. Mr. William Henry Smith is personally a heavy loser by the destruction of rare books and papers, many of which cannot be duplicated. Among these were hundreds of rare pamphlets collected by Stevens in Europe, which Mr. Smith supposed were secure in this "fireproof" building. An extensive correspondence of great value was also consumed.

The telegraph company has divided its operating force among sub-offices at Twenty-third street, Jersey City, Brooklyn, and Weehawken, from which business will be done temporarily. Meanwhile quarters are being prepared at the old Baltimore and Ohio office at No. 415 Broadway, and part of the clerical staff has gone to the building at the corner of West Twenty-third street.

The United Press courteously tendered its facilities during the break, and the Postal Telegraph Co. secured a large part of the work. Owing to the interruption of the Western Union cable service, the Commercial Cable Co. has been crowded with extra business.

The loss to the Western Union Co. is estimated at $300,000. The company carries its own insurance.

The telephone was not used very much for press news, however, and officers of the Western Union said that they did not attempt to forward messages by means of it. There was, however, a great demand for it among persons who had imperative messages to dispatch, and it proved to be of great advantage for them. At some of the public telephone stations complaints were made that the wires were in such demand that it was extremely hard work to secure connections. Even at night the telephone company did a rushing business, and all its wires and operators were fully occupied.

Telephone wires were available to Boston and Philadelphia, in the evening. The demand from senders of messages was very great.

STEAM SUPPLY IN NEW YORK CITY.

W. C. Andrews, President of the New York Steam Company, and James W. Hawes, the counsel of the company, appeared before the board of health last week in opposition to the orders recently made by the board ordering steam to be shut off from certain sections of the company's plant within three days. Mr. Andrews argued that it had not been shown that the business of the company was either dangerous to life or detrimental to health. The business of the company, he said, amounted to $2,000 a day, between 3,000 and 4,000 buildings were supplied with steam, and 600 engines were furnished with steam by the company. To close these operations at short notice would cause great hardship and inconvenience, he contended. The board agreed to give the company another hearing this week. In the meantime, commissioner Gilroy has revoked all their permits for street opening, in spite of the protests of the company that injury is thereby inflicted on the public, or such portion of it as uses the company's product.

LEGAL NOTES.

LONERGAN vs. LAFAYETTE STREET RAILWAY CO., et al.

In the above case Judge B. W. Langdon, of the Indiana Circuit Court, sustained the demurrer to the complaint, and decided in favor of the electric railway. We give below an abstract of his decision:

The question presented arises on the demurrer for a want of sufficient facts to the complaint asking for a perpetual injunction against the railway company, prohibiting it from operating its cars by electric power and for damages for injuries suffered in consequence of the past use of that motor. The facts material to be noticed now are that the plaintiff is, and was before the construction of the defendant company's railway, the owner of a lot abutting on Main street near its western extremity in Lafayette, together with the iron works and blacksmith shop thereon, where he is and has been operating the same.

It is then alleged that neither the Common Council of the city nor the Board of Commissioners had any power to authorize the use of Main street, the bridge or highway adjoining for the purpose of operating a railway by electrical power, and the grants made by them are void, wrongful, and injurious to plaintiff's property rights and business. That the company claims the right and threatens to continue the use of its electric cars on Main street and bridge for 21 years, the time mentioned in its license. Prayer, as stated, for perpetual injunction, $500 damages, and general relief. It should be borne in mind that for the purpose of this case, according to the allegations of the complaint, that all the ordinary conditions usually found in the construction and operation of a horse railroad are present in the defendant company's railway, except those which relate to the matter of the motor power.

To determine whether a use of a street is without the original public easement, it is quite plain that the inconvenience complained of must be tantamount to a substantial impairment of the public use. In other words, that the use of the street is destroyed or converted into a new use, subversive of the original purpose. If the general public use and operation of the new motor are substantially consistent, they are homogeneous, and the locomotion of the cars by electricity or animal power is a mere matter of fact, and imports no substantial significance, because no new burden is imposed and no private property is taken in contemplation of law. The averments in the complaint relevant to this part of the matter are in fact not about the motor itself, but are rather about its manifestations, or the phenomena that follow from its operation. These manifestations are covered by the following allegations: That by reason of the propulsion of the cars by electric power they are driven much more rapidly than by animal power, and in passing over the street they make a loud, churning and pulsating noise, accompanied by a peculiar humming sound, and with the electric wire under the rail, produce constant flashes of electric light, especially at night and in damp weather, and are without visible means of locomotion. It is then alleged that these several facts cause fright to horses not long accustomed to these sights and sounds when approaching or are being approached by the cars, and they become uncontrollable and run away, and thereby frequent accidents occur. That the fright to such horses and the dangers incident to it have created apprehensions of danger upon the street, and it has become widespread in the community, and has the effect of driving trade and business from this street. The sum of the averments is that some horses not long accustomed to the movement of the cars by the electric motor become frightened and frequently run away. Does then the fact that some horses not long accustomed to the alleged manifestations show that there is a use of the street that is substantially inconsistent with the general public use of it? It is admitted, by implication at least, that horses will become accustomed to these sights and noises, and are tractable as usual. It comes to this, that some horses at first become so frightened until they are broke or familiarized with these sights and noises. It is plain that this inconvenience is temporary and not permanent, or insuperable, nor does it extend to the general public who are driving horses in the street, but is limited to those only who are using such animals. It is a fact and within the common knowledge of all who have observed the operation of these cars in the presence of horses, that the difficulties in their management are overcome in a comparatively short time, except in a few cases, and the streets are and can be used by the entire public passing over the street, in reasonable safety, and without any substantial impairment of the known legal right of any one. Effects not unlike these complained of are witnessed and have been since streets have been used for the movement of processions, parades, shows, passage of machinery or vehicles creating unusual sounds or noises or strange appearing sights, and it has never been considered that such a use was evidence of any additional burden or recognized as furnishing any legal basis for actionable wrongs where proper care was observed. It has been held that a change of motor can not be deemed a change in the use of the street. I do not think the averments raise the legal conclusion that there is such a substantial and permanent impairment of the use of the

street by the general public, that it can be inferred that an additional burden has been imposed; and if the defendant company has been authorized by law to use the motor complained of, the depreciation in the value of the plaintiff's property and business is not recognized by the law.

The plaintiff next maintains that the statute does not grant to the defendant company the right to use the electric motors to propel cars over the land in front of his lot, and that entitles to relief. The statute authorizing the chartering of street railways and prescribing their powers and duties, provides that a corporation may be formed by not less than five subscribers to the stock of any contemplated street or horse railroad company, for the purpose of constructing street or horse railroads upon and through the streets of the cities and towns in this state (ss. 4143 R. S., 1881; ss. 1 Act 1861, p. 75). The title of the act reads in these words: "An act to provide for the incorporation of Street Railroad Companies" The plaintiff insists and correctly, too, I think, that this act should be interpreted in the light of the circumstances and knowledge existing in 1861, when the act was passed in reference to the operation or locomotion of street cars. It is claimed that since street cars were then only propelled by animal power, it is reasonable to assume that the Legislature intended to enable companies organized under it to construct and maintain a horse railroad, and to exclude the use of any other motor. The paramount purpose of the Legislature in enacting the statute authorizing the use of a new and improved mode of travel in cities, was the public convenience. Especial regulations are imposed in reference to gradient and location, but nothing is directly said about the motor. The motor was not a controlling or noticed matter in the immediate purpose of the act. If the prime object was the accommodation of the local public, by the use of this sort of conveyance, how can it be reasonably asserted that this accommodation of the same public by the same way should be restricted to the use of an instrumentality which is only a subordinate means to the ultimate end in view, the accommodation or convenience of the public. If it is correct to say that public utility and convenience are the underlying considerations for establishing authority for the operation of street cars, it would seem that the propelling power should fall within the same consideration as the principal thing. In other words, that public utility or convenience should operate throughout and when it requires it, that the motor should be modified or superseded when not inconsistent with enjoyment of the public easement in the street by the general public, and in the absence of any declaration of a contrary intent it would seem rational to infer that such was the intent of the legislature. The act was passed at a time when it was a matter of common knowledge that mechanical devices were being daily discovered, and were practically applied in almost every department of public and private economies. The legislature was cognizant that science and skill was occupying wider and deeper fields of thought, and activities, and new discoveries were used wherever and whenever time, money, health and the convenience of the people required them. It would seem, in such a case, to be an inversion of the true intent and understanding of the legislature to say that all the useful invented appliances of the future should be excluded from public enjoyment, and that the horse or other animal should alone be utilized to propel street cars. The statutes speak of a street railroad in the enacting clause, and in the body of the acts, as street or horse railroads, and this language is sufficiently broad to cover a street railroad whether the cars are drawn by a horse or propelled by the power of an electric dynamo, and the defendant company is in the legitimate exercise of its charter power in using the same. In the view I have taken of the pending question, it is not necessary to examine other questions submitted. The demurrer to the complaint is sustained.

At the conclusion of the decision the plaintiff gave notice of appeal.

PATENT NOTES.

THE DE FERRANTI AND WESTINGHOUSE INTERFERENCE.

On appeal from the Examiners-in-Chief, the Commissioner of Patents has decided the interference between De Ferranti's application of April 18, 1887, and Westinghouse's patent of July 12, 1887, for improvements in electric converters, in favor of the latter, affirming the decision of the Examiners-in-Chief. Priority was awarded to Mr. Westinghouse under the ruling that "under the present British Statute, a British invention cannot be said to be patented within the meaning of sections 4,886 and 4,887 of the Revised Statutes, until the final act of affixing the Seal." The Westinghouse application was filed December 27, 1886. De Ferranti's English provisional specification was filed September 9, 1886. The date of sealing and issue of De Ferranti's English patent was February 15, 1887, subsequent to Westinghouse's application.

THE ELECTRIC LIGHT IN SAXONY.

A cable despatch from Frankfort, Germany, says that a syndicate has obtained a concession under which it will light electrically 168 Saxon towns and cities.

REPORTS OF COMPANIES.

CONSOLIDATED ELECTRIC LIGHT CO., OF NEW YORK.

The statement of the Consolidated Electric Light Company, of New York, for the period ending July 1, 1890, shows quarterly dividends for 15 months ending April 1, 1890, $126,271. From the income for the period ending June 30, 1890, there has been applied to the sinking fund for payment of bonds at or before maturity, $14,600; quarterly dividend of 1¼ per cent. payable July 1, $30,355. The total issue of bonds due in 1893 and 1895 was $325,000. There were purchased and carried to sinking fund, $141,800; bonds still outstanding, $183,200; total amount cash applied to sinking fund, $133,911; cash required under lease to be applied to sinking fund on June 30, $87,600; surplus, $46,311.

NEW YORK EDISON ILLUMINATING COMPANY.

General interest has been aroused in the news published first in these columns last week to the effect that Mr. John I. Beggs would resign the important position of vice president of the Edison Illuminating Company of this city, to assume new duties as manager of the Central District for the Edison General Electric Company. Since Mr. Beggs came to this city from Harrisburg, he has seen the business, then restricted to the Pearl street station, increase in a remarkable manner, so that there are now three main stations, the two new ones on West 26th and West 39th streets and the renovated Pearl street station, these in turn to be shortly supplemented by the big new station on Elm street, which is to take care of the region from Eighth street to the Battery.

The figures of the period from January, 1887, to July, 1890, bring out the growth very clearly. At the date named—the beginning of 1887—the local company's gross earnings were at the rate of $157,000 per year. Now they are not very far short of $750,000, or $2,000 per day the year around. There were then 500 customers; now there are 15 0. The number of lamps connected up was 12,489; now the number reaches 50,000, with the addition of 250 arc lamps, a branch of the business untouched in 1887. At the beginning of that year, the company did no motor business; now it furnishes daily 600 h. p. of current, and finds new work for motors every day. The number of employees has grown from 32 to no fewer than 532. Mr. Beggs has also installed 25,000 lamps in isolated plants throughout the city. A regular supply department, as large as an ordinary supply house, has been established and conducted profitably, and the company has done its own wiring with marked success. With such a showing as this, it need not be wondered at that the directors of the company have been reluctant to let Mr. Beggs give up his work here for the new sphere of labor in the West.

STOCKS AND BONDS.

THE SEDALIA, MO., ELECTRIC RAILROAD, LIGHT AND POWER CO. has increased its capital stock from $80,000 to $200,000.

THE GATE CITY ELECTRIC CO., of Kansas City, proposes increasing its capital stock from $10,000 to $30,000.

THE EDISON ELECTRIC LIGHT AND POWER CO., OF KANSAS CITY, has increased its capital stock from $100,000 to $150,000.

DIVIDENDS.

THE CHARLESTON, S. C., ELECTRIC LIGHT AND POWER CO. has declared a dividend of 75 cents per share.

THE CUMBERLAND TELEPHONE CO., Nashville, Tenn., has declared a quarterly dividend of 1¼ per cent.

OBITUARY—THOMAS E. QUINN.

Thomas E. Quinn, the oldest telegraph operator in the employ of the New Jersey Central R. R., died on Sunday, July 7, at Washington, N. C., where he had gone for the benefit of his health. He was manager of the Western Union office at Elizabeth, N. J., during the war, and had been in the employ of the company over thirty years. He was one of the best-known railroad and telegraph men in the State, and was fifty-five years of age.

OBITUARY—J. MARSHALL GLEASON.

We regret to announce the death, in his sixty-seventh year, of J. M. Gleason, the youngest brother of Mr. E. P. Gleason, of the well-known house of E. P. Gleason Manufacturing Co.

He died somewhat unexpectedly, of bowel and liver trouble, having been confined to his house in Brooklyn only a few weeks. He was custodian of the Brooklyn glass works of the concern, his son, Mr M. Wilfred Gleason, being the manager. The deceased was well-known to many electricians from having attended several of the conventions of the National Electric Light Association, and left behind him a large circle of friends, made by his fatherly, generous and charitable instincts displayed on many an occasion

in a quiet way. The funeral services were held at his residence in Java street, Brooklyn, and the burial took place on Saturday, July 12, in the Gleason family plot in Greenwood Cemetery. A large number of employees from the Brooklyn glass works and the New York factory and offices attended the funeral services.

METAL AND SUPPLY MARKET.

THE PRICE OF COPPER.

The course of prices for copper during the past year has been very different from that generally predicted after the collapse of the French speculation a year and a half ago. It was commonly believed that the enormous surplus stock accumulated at that time could not be marketed without breaking prices to very low figures for a somewhat protracted period. But the sharp rise of last October has been followed by a tolerably continuous increase. Consumption has been greatly augmented, the electrical demand alone serving to take up a great part of the Lake product. Prices in New York from July 11 to July 19 were as follows:

11	12	14	15	16	17	18	19
16.30c.	16.50c.	16.50c.	16.50c.	16.60c.	16.50c.	16 50c.	16.75c.

The prices 12th and 19th are those to which margins were called in the Metal Exchange. The other prices given are the rates bid. Holders asked .20 to .40 above these rates. The price July 19, 1889, was 11.90. Very little copper changed hands during the week.

ELECTROLYSIS OF THE MUSCLES.

In a recent number of the *Bulletin de la Société Belge d'Electriciens*, Dr. G. Weiss contributes a brief account of some interesting electro-medical investigations undertaken by him. That electrolytic effects take place at the electrodes where an electric current enters and leaves the human body is, says Dr. Weiss, universally admitted; but is the electrolytic action confined to these points? Dr. Weiss then points out how, when intermittent currents of the same strength are sent along the gastronemian muscles of a frog's leg, the contractions rapidly cease, and no amount of rest restores the muscles to their primitive condition. On the other hand, the duration of an alternating current does not perceptibly affect the contractions. This phenomenon points, therefore, to electrolysis of the muscle along the entire path of the current. Dr. Weiss then tested this theory as follows:—He took two vessels containing a one per cent. solution of chloride of sodium, connected them by a syphon filled with the same liquid, and passed a given current from vessel to vessel, using platinum electrodes. The experiment was then repeated with the two hind legs of a frog as connecting piece. The E. M. F. of polarization was considerably greater in the latter case than in the former. Dr. Weiss is of opinion that an electric current traversing a muscle gives rise along the whole length of its path to chemical decompositions, and that the products of these give rise in their turn to powerful secondary actions upon the substance of the muscles, which are rapidly attacked and destroyed. Microscopic examinations showed that the entire structure of a muscle was gradually altered by the passage of a current. Dr. Weiss then poured a strongly saline solution of gelatine, colored with well neutralized turnsol, into a U tube, and when the gelatine had solidified he poured in water colored in a similar manner. The turnsol not only changed color at the platinum electrodes but also at the surface, separating the gelatine and the water. With albuminous water the albumen was coagulated at the positive and completely dissolved at the negative surface of separation.

NEW ELECTRIC LIGHTING BIDS FOR NEW YORK CITY.

The new bids for street lighting from the electric lighting companies were opened last week by the Gas Commission. The companies' bids had twice been rejected as too high and calculated to make the cost of street lighting exceed the amount appropriated for this year. The new bids were: United States Company, 236 lamps at 35 cents a night each until Jan. 1 and 43 cents thereafter; the Brush Company, 165 lamps at 35 cents and 69 at 45 cents until Jan. 1, and afterward 165 at 43½ cents and 69 at 45 cents; the East River Company, 189 lamps at 35 cents to Jan. 1 and 43 cents thereafter; the Mount Morris Company, 109 lamps at 35 cents to Jan. 1 and then 43 cents; the Harlem Lighting Company, 104 lamps at 35 cents to Jan. 1 and 43 cents afterward. The members of the Gas Commission referred the bids to Secretary McCormick for tabulation and report. If they do not fit the appropriation, Commissioner Gilroy says he is prepared to go on and light the city with gas.

A LARGE ELECTRIC TRAVELING CRANE PLANT.

The Equitable Electric Railway Construction Co., of Philadelphia, Pa., are installing for the Southwark Foundry and Machine Works (builders of Porter-Allen engines), 5th street and Washington avenue, Philadelphia, Pa., what is supposed to be the largest electric traveling crane plant ever built up to the present time. There are two Sellers traveling cranes of 50 tons capacity, each running side by side in the foundry, which is about 400 feet long. The cranes run backward and forward over this entire distance, lifting heavy castings out of the sand. Each crane is being equipped with one 35 h. p. Sprague standard motor, and the two are supplied from a 50,000 watt Edison compound generator situated at one end of this building, driven by a Porter-Allen high speed engine. The current is conveyed to the motors through a Wheeler double trolley, running on a silicon bronze overhead line. Similar plants have been installed by the Equitable Electric Railway Construction Co., at the Pennsylvania railroad shops at Altoona, Pa., and Wm. Sellers & Co., Philadelphia.

ELECTRIC RAILROADS AT NASHVILLE, TENN.

At the recent meeting of the American Society of Civil Engineers, Prof. O. H. Landreth presented a paper on "The Electric Street Railway System of Nashville, Tenn.," in which he noted its remarkably rapid development and extension resulting from the change from mules to electricity. There are now 64 miles aggregate length of track, and over 100 cars. The overhead single trolley system was employed. The power developed was 670 nominal electrical horse power at 500 volts pressure. He described the plant, its details and operation, estimating by three different methods the total amount of power developed, and gave data of the effective power, cost of production, etc. In discussion it appeared that the operating expenses are very little increased, and the receipts are nearly doubled, both by expansion of the line and increased speed, which induces people to ride for pleasure. It was very much more economical than animal power.

In Washington, D. C., a new system is soon to be built having a main circuit and local ones with connections about 90 feet apart. This system has given good results on a 2,000 foot line, and is economical in construction, the feed-cable, trolley, wires, yokes, etc., being on top of the ties and very accessible.

WESTINGHOUSE ALTERNATING CURRENT MOTOR.

The Westinghouse Electric and Manufacturing Company are now making a new alternating current motor, which they claim, owing to its many advantages over any similar motor, is bound to become a great success. As it does not require any higher tension than the ordinary fifty volt alternating current, its usefulness makes it especially commendable for the operation of sewing machines and other minor requirements of power. The company has already received orders for five hundred motors.

INVENTORS' RECORD.

Patents issued July 15.

Alarms and Signals:—*Burglar Alarm*, J. H. Pruitt, 432,077.

Conductors, Conduits and Insulators:—*Conduit for Electric or Cable Railroads*, J. Lynch, 432,416.

Distribution:—*Means for Generation and Conversion of Electrical Energy*, A. De Castro, 432,022. *Induction Coil or Transformer*, C. E. Kammeyer, 432,050. *Regulation of Arc-Light Circuits*, D. Higham, 432,310.

Dynamos and Motors:—*Dynamo Electric Machine*, F. A. Perret, 432,169. *Commutator-Brush*, J. F. McLaughlin, 432,206. *Armature of Dynamo-Electric Machines*, O. A. Enholm, 432,387. *Armature*, E. Wagemann, 432,500.

Lamps and Appurtenances:—*Electric Arc Lamp*, E. C. Russell, 432,284. *Manufacture of Carbon Conductors*, A. de Khotinsky, 432,490.

Measurement:—*Electric Meter*, P. H. Korst, 432,053.

Miscellaneous:—*Water Conveyer*, G. W. Bailey, 431,542 (issued July 8). *Electric Stop-Motion for Warping Machines*, J. P. Haslam, 432,040. *Current Regulator or Rheostat*, O. Flemming, 432,131. *Coin-Actuated Device*, P. Kennedy, 432,163. *Electric Cigar-Lighter*, R. Graham, 432,197. *Electric Heater*, J. F. McLaughlin, 432,205. *Electric Switch*, J. F. McLaughlin, 432,207. *Electric Clutch*, J. F. McLaughlin, 432,209. *Apparatus for Detecting Short Circuits*, H. Redding, 432,215. *Electric Switch*, A. G. Frey, 432,234. *Current-Regulator or Rheostat*, G. B. Massey, 432,279. *Animal Clipper*, C. M. Palmer, 432,438. *Graphophone*, J. H. White, 432,462.

Railways and Appliances:—*Electric Railway*, R. M. Hunter, 432,019. *Trolley*, W. C. Miller, 432,063. *Electric-Railway Switch*, W. D. Swart, 432,095. *Electrically Propelled Vehicle*, R. M. Hunter, 432,136. *Electric Locomotive*, W. H. Knight, 432,142. *Means for Electric Locomotion* J. F. McLaughlin, 432,204. *Electric-Motor Car*, J. F. McLaughlin, 432,208. *Electrically Propelled Vehicle*, J. W. Henderson, 432,237. *Multiplex Electric Locomotive*, C. J. Van Depoele, 432,345. *Electric Car*, E. Wagemann, 432,501.

Secondary Batteries:—*Electrode for Secondary Batteries*, J. F. McLaughlin, 432,202.

Telegraphs:—*Telegraphic Relay*, J. M. Treber, 432,098. *Printing Telegraph*, W. W. Taylor, 432,453.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

THE ELEKTRON MANUFACTURING CO.

The Elektron Manufacturing Co. have recently added largely to their cash capital to enable them to handle properly their large and constantly increasing business, and they have doubled their manufacturing facilities twice during the last six months. They now occupy nearly all of the large new factory building, Nos. 79–81 Washington st., Brooklyn, N. Y. Their works are notable for fine machinery, whereby all parts are made accurately and interchangeably to standard gauges, and for the methodical and careful arrangement of their business. A fully illustrated description will be found in this issue of their new slow speed Perret motors.

FISHKILL CORLISS ENGINES.

The Fishkill Landing Machine Co., Fishkill-on-the-Hudson, N. Y., have just issued a new edition of their illustrated pamphlet relative to their well known Corliss engines, which embody a great many special features of excellence. Accompanying the description are a large number of references and several testimonials from users of the engines. The concern have also issued another edition of their boiler circular relating to their horizontal tubular boilers.

THE ELECTRICAL SUPPLY CO., CHICAGO.

The above concern has recently issued a very neat and effective circular relative to its Wirt lighting arrester, recently illustrated and described in our columns. The essential part of the Wirt arrester, which is broadly covered by patents, is a series of conducting plates wholly insulated from each other and having a very small space between them (from $\frac{1}{1000}$ to $\frac{3}{1000}$ of an inch), the discharge being made to pass over all the breaks in series. Each arrester is provided with terminal wires, to be joined to the line, and ground wires, thus avoiding screw connections.

EUREKA TEMPERED COPPER FOR ENGINE BEARINGS.

The Eureka Tempered Copper Co., of North East, Pa., have recently received the following letter from M. C. Connell & Co., of Hornellsville, N. Y.: "In reply to your favor of the 9th. inst. would say that we have been using your tempered copper for bearings on our engine for about six weeks, and we find it better than any we have before used. It is giving good satisfaction and we are well satisfied with it."

THE JEROME KIDDER MANUFACTURING CO.

The above company are recently in receipt of a number of testimonials as to their electro-medical apparatus. The following will serve as a sample :—

Office of Indiana Sanitarium, }
Brookville, Ind. }
Dr. S. P. Stoddard, Prop. } May 2d, 1890.

Jerome Kidder M'f'g. Co.,
820 Broadway, New York,

Please send by American Express one No. 5 Tip Battery with sponge electrode, etc., complete. * * * The first of these tip batteries I bought of you, I sent in 1873 to a friend in Omaha. The last was in 1888 or '84 when I had an office at West 45th street New York. Since then I have been persuaded into dry cell, chloride of silver and all sorts of others, two of which are now in my house, but none have ever done for me so much work and done it so well as your No. 5. I enclose draft on New York. Sincerely,

S. P. Stoddard.

ELECTRICITY IN JAMAICA, WEST INDIES.

A short time ago we published a very interesting article by Mr. A. Livingston Bogart on the electrical status of Bermuda. Mr. Bogart showed that that old British colony, with its new Halifax cable, was well in line with modern electrical work and ideas. Mr. H. C. Wilson, the Superintendent of Government Telegraphs in Jamaica, is now on a visit to the United States, and informs us that the "Isle of Woods and Springs" is also in the van so far as electricity is concerned. The telegraph service, which was established in 1879, now has 48 offices open, 8 more to be opened, 1,000 miles of line, and a staff of about 150 employés. The lines are worked on the single current system, with Siemens polarized relay and Daniell battery. The principal offices are Kingston and Port Antonio, the latter place being very busy owing to the enormous growth of the American fruit trade. There is also a good telephone system. Recently a local electric light company has been formed which has put in a fine Thomson-Houston plant, using good construction materials, such as Simplex wire, etc. The company is already an assured success. Several isolated plants are also being put in, and one has just been started at the new American Hotel at Constant Springs. It is now proposed to operate the street railway electrically. Jamaica will hold a Tropical Exhibition beginning January, 1891, when a good electrical display will be made.

APPARATUS BUILT BY BOYS.

Some most creditable work is now being done in the electrical classes of various educational institutions, and well worthy of note is some of the apparatus constructed during the past year by the students of the High School, Newark, N. J., under Prof. Sonn. The first of a series of prizes was taken by a fine Ruhmkorff coil, which has now been brought into daily use in the school. It is more powerful than that purchased for the use of the class, for which $40 was paid. Made by the same boy was a Holtz frictional machine, modelled after a machine worth $100, and described as being a very fine piece of workmanship. Among the apparatus handed in for competition were microphones, electro-magnets, galvanometers, electric motors, Leyden jars, and all kinds of electrical appliances. As there is no workshop in the school, most of the boys have been obliged to do their work at home. This is such a manifest disadvantage that Prof. Sonn of the Physics class is in hopes of having a shop, fitted with lathe and other appliances, built for the use of the boys. This is a most commendable lead. It is beyond question that a superior order of manual training has now become necessary, not only from the shop work of the technical school, but because of the intellectual development induced by doing and observing rather than merely studying. The practical teaching of electricity in schools will eventually be adopted, and its results will speedily be seen in the raising of the standard of electrical artisans and craftsmen.

THE SANDWICH ISLANDS CABLE.

John T. Waterhouse, the Honolulu capitalist, returned to this city yesterday, says the San Francisco *Chronicle* of July 10, from an extended Eastern visit. Mr. Waterhouse was one of the prime movers in the financial proposition of establishing an ocean cable between this city and Honolulu, and his Eastern trip was on business connected with the proposed cable. Mr. Waterhouse is evidently not at all pleased with the result of his Eastern trip, for in conversation last evening he said : "Business at the islands and the trade with this country are at a standstill. The recent elections at Honolulu and change in the cabinet and other administration offices have, of course, placed business men and capitalists on tenter-hooks, but nothing as compared with the effects of the tariff question."

Notwithstanding his failure to interest the leading Eastern capitalists in the Hawaiian cable proposition, Mr. Waterhouse said that while he had accomplished practically nothing there was still a large degree of progress in the movement from a new and outside source.

"English capital vested in American syndicates," said Mr. Waterhouse, "has been slowly absorbing many leading American industries, and the syndicates are now looking for connections outside of the United States, and more especially at Honolulu and in the Australian colonies. The colonies are developing very rapidly, and a telegraphic communication with San Francisco will soon be an absolute necessity. I dare not tell just what is being done in this matter, but rapid progress is being made."

Mr. Waterhouse intimated that an English syndicate was arranging to build a great ocean cable line from San Francisco to Honolulu and thence to Melbourne and other points in Australia.

AN ELECTRIC ROAD FROM BROCKTON TO BOSTON.

A special dispatch from Brockton of July 16 says :—The outlook for constructing a system of electric street railways, which will finally connect Brockton and Boston, looks more hopeful after to-day. The petition of the East Side street railway for a location in this city to the boundary lines of Abington, Holbrook, Avon and Easton was considered by the board of alderman, and granted, with the usual restrictions. Among those present at the meeting of the aldermen were the East Side directors, the selectmen of Randolph and several other gentlemen who would not divulge their names or business. It is said they represented New York and Boston capitalists who are interested in the proposed system of railroads. The plan proposed in connecting Brockton and Boston is to build the road as far as Neponset, where it will connect with the West End system. There is an electric road in Quincy already, and one is to be built this summer in Randolph. There will be 15 miles of road built in this city. The prime mover at the head of this scheme is said to be one of the car motor concerns, whose object is to have a system constructed which will be open for the inspection of capitalists in other towns and cities. The East Side road has asked for a location in Avon, and others are demanded in Holbrook, Randolph, and possibly Braintree.

Long Branch, N. J., is agitating the subject of an electric road and hopes soon to get one, although the first application, by the Monmouth Electric Railroad Co., for a borough franchise, was refused last week.

THE WESTINGHOUSE ELECTRIC COMPANY'S RAILWAY WORK.

The first electrical equipment turned out by the Westinghouse Electric Company was put in operation on the Pleasant Valley road, on July 4th, and has been in daily operation ever since, without a hitch of any kind, in marked contrast with motors of less substantial construction.

The motors heretofore made for street railway purposes have generally required the use of wrought-iron pole-pieces, and a necessarily complicated construction. The motor made by the Westinghouse Electric Company, however, does not require wrought-iron pole-pieces. Its principal part is a strong and rigid cast-iron frame, which carries the bearings and pole-pieces. The gear-wheels and pinions have broader faces than those heretofore made; in fact, everything about the apparatus indicates strength and reliability. The caps for the bearings and the pole-pieces are arranged so that the armatures, coils and field magnets can be conveniently removed for the purpose of repairs, and there is used an electric governing apparatus of novel construction which seems to possess advantages over all forms heretofore tried.

To protect the gears from rapid wear, and to deaden the sound, it is proposed to surround the gear-wheels by a cast-iron dust-proof box, which will contain a sufficient amount of oil to keep the teeth of the gears constantly lubricated. This lubrication will lessen the friction and the noise, and the box which will surround the gears will so far deaden the sound as to make it unobjectionable. The noise made by apparatus which has been in use a considerable time, and which has become badly worn, has grown into a nuisance, and street railway officials generally are expressing the hope that some way may be found for transmitting the motion from the motor to the car axle without the use of gear-wheels, for the reason that they are not only troublesome on account of the noise, but because the rapid wear involves heavy expenses for repairs.

ARMINGTON & SIMS ENGINE COMPANY.

We have received from the Armington & Sims Engine Co. a beautiful album of views of Providence, R. I., and of the leading manufacturing establishments of that rich and busy city. The first view shown is that of the Armington & Sims Works, a handsome and substantial collection of factory buildings commodiously grouped for the production of engines known around the world, and that have won everywhere the highest encomiums for American mechanical genius and skill.

THE MEN WHO SUCCEED.

Young mechanics make a very egregious mistake, says the *Builders' Gazette*, when they begin to think that they do too much for their employers when they work a few moments overtime to complete a small task they are performing, just at the time the whistle blows to quit work. More young men have been kept from receiving an advance in their wages from this than from any other known cause.

Employers watch the movements of young men very closely, and the least little thing oftentimes places them in an unfavorable light before their employers. It is the young man who studies the interest of his employer, and is not afraid to give him a few moments, that gets the rapid advancement. He is the young man selected when there are any favors to be granted.

I can tell in twenty minutes in any workshop the young man who is most likely to succeed in his trade. He is the last to leave his work, and is always prompt in beginning it. These fellows that drop their work at the moment the whistle blows are always the ones that the employer is ready to discharge when business gets a little slack.

The young man who takes the interest of his work at heart, and his employer into consideration, is very rarely laid off in slack times.

HARRIS-CORLISS ENGINES FOR LOWELL.

The electric light company at Lowell has received the new 500 h. p. engine made by the Harris-Corliss Co., of Providence, and the foundation for it and those of the boilers will be completed at the new plant this week. The new plant will be ready for operations next month. Four new boilers will be put in.

NEW ENGLAND TRADE NOTES.

The Standard Electric Co. of Vermont, have just shipped to John M. Sharpless & Co., of Chester, Pa., a 200 incandescent light plant, ordered through their Philadelphia office.

President H. A. Pevear, of the Thomson-Houston Co., with Mrs. Pevear, his son, H. T. Pevear, and wife, and Mrs. T. F. Bancroft and daughter, starts this week on a trip to Alaska.

Paine & Francis have received the order to furnish two Edison 500 light dynamos, for the new Exchange Building on State street, which the New England Wiring and Construction Company are at present fitting up with the "interior conduit" system.

The Electric Mutual Insurance Company is about to appoint a new inspector, the volume of its business making such action necessary. This week, too, a meeting of the stockholders will be held to increase the number of directors to 15, several prominent electricians to be added to the present board.

The New England Wiring and Construction Co. have received the contract to wire the Chamber of Commerce, Central Wharf, Boston, for over 1000 lights capacity. The "interior conduit" will be used throughout, and there will be no gas piping whatever in the building, which will be connected to the general Edison system of Boston. They are also at present wiring for about 225 lights the Bradley building, on Tremont street, which also will take its current from the Edison station.

The Evans Friction Cone Co. have received orders to equip the new station of the Leavenworth Electric Light Company, of Leavenworth, Kans., with their frictional system of driving dynamos. The station has been especially designed for using the Evans system, and will consist of two compound Ball engines, five Thomson-Houston arc machines, and three Heisler dynamos. The shaft on which are the pulleys to drive the dynamos, will be coupled direct to the engines. The Evans Co. are also in receipt of an order to equip two Thomson-Houston H. I. dynamos at the Cocheco Mills, Dover, N. H., with their frictional system of driving.

Pettingell, Andrews Co. have secured the agency for New England, New York State, Pennsylvania and Eastern Canada, of the "Tested Fuse Wires," tested by the Massachusetts Electrical Engineering Company. These fuse wires and American Safety fuses are made of the best material and tested and guaranteed by the Massachusetts Electrical Engineering Company, and are meeting with great success since their introduction a few weeks ago. All orders from the above mentioned States must be sent to Pettingell, Andrews Company, and new agencies for other States will soon be made.

WESTERN TRADE NOTES.

Mr. G. R. Noyes has accepted the position of manager of the Chicago Electric Club. Mr. Noyes is a graduate of Harvard and the management are to be congratulated on their selection.

Mr. J. C. Liggett, of the Milwaukee Edison Company, was in town this week investigating the various systems and arrangements of the electric lighting plants in the Chicago theatres with the view of adopting the best points embodied therein in a similar plant he is about to install in Milwaukee.

Mr. J. L. Barclay has removed the offices of the Westinghouse Electric Railway Company from the Rialto building to a handsome suite on the ground floor of the Pullman building. Their new quarters are very roomy, and are being handsomely and tastefully fitted up.

Mr. G. A. Edward Kohler, Western manager of the Eddy Electric Motor Co., of Windsor, Conn., has just sold a 3-horse power motor to Ederer & Co., 151 Wabash avenue, where it will be employed to operate machinery for manufacturing fishnets. The electric motor is slowly but surely finding its way into every possible class of manufacture.

The Electrician's Time Co. is the name of a new company just organized in Chicago to do a business in watches, diamonds, jewelry, etc., principally amongst electrical men. Their offices are located at 167 Dearborn street, room 416. Very special inducements are held out to electricians and all should patronize the new company. Mr. L. W. Collins, the late genial manager of the Electric Club, represents the company.

The Knapp Electrical Works are doing a brisk trade all the time in their various specialties. In addition to their Grimshaw wire they are selling a large amount of the American Electric Works line wire for pole work. The Knapp annunciators still find a ready market as always, and quite a number of electric motors for ventilating purposes and other classes of work are being sold.

The Sunbeam Incandescent Lamp Co., cor. Randolph and Canal streets, are taxed to their utmost capacity turning out their lamps. These lamps are manufactured to fit any socket, have a remarkably long life and do not blacken. The efficiency is also high, and there is no diminution of the rated candle power during the whole life of the lamp. Mr. Cook, the treasurer of the company, has just returned from a trip, and has brought away with him some nice orders.

The Electric Merchandise Co. are doing a remarkably large business in electric railway supplies, to which they give their undivided attention. They are bringing out new and valuable specialties in this class of work all the time and their devices are meeting with widespread adoption by electric railroad men in all parts of the country. Their latticed iron poles, which are manufactured specially for them by the Wisconsin Bridge and Iron Company, are in especial demand and meet a want which has long been felt.

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New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.
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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers*

VOL. X. NEW YORK, JULY 30, 1890. No. 117

I have examined piles of broken rails, links, pins, wheels and axles and have never been able to discover a fracture in good honest material.—William S. Huntington.

THE WORK OF THE STREET CARS.

According to figures compiled recently there are now nearly 9,000 miles of street car track in this country and Canada. The figures furnished us by the *Street Railway Journal*, in response to an inquiry, are as follows, being derived from the latest returns received from street railway companies :—

Miles of Horse Railway	5,902½
" " Electric	1,753
" " Dummy	556
Cable,	441
Total mileage	8,652½
Number of Electric Roads	264
" " Cable "	44

It will be seen that the electric roads begin to play a very important part in the street railway field, exceeding 25 per cent. of the mileage and of the number of roads, which are not far short of 1,000. When we remember that street railways have been running since about 1832, and the electric roads, as a practical commercial service, since 1885, it will be seen that electricity has developed and conquered at an amazing rate.

It is no wonder that the problems of street railroad work are so attractive to electrical inventors and electrical engineers. They begin to realize the magnitude of the field, its possibilities, and the fact that it is theirs in a peculiar and special way. It is also a good training school for the heavier work that awaits beyond in operating many of the present steam railroads.

The work of the street railroads in the urban transportation of our people is enormous. In St. Louis it has been found that the whole population is carried 110 times a year by the street cars. In the State of New York the surface street railways, 91 in number, carried 368,496,648 passengers during the year ending September, 1889, or the whole population of the State fifty or sixty times. If we added the 217,000,000 of the elevated roads, it would make the population of the whole Empire State ride not less than eighty or ninety times a year in the street cars. Probably such high ratios do not apply over the whole country, but the figures are still very striking, even if minimized. There are slightly over 29,000 street cars, open and closed, in America. If, say, 18,000 of these are in daily commission and carry no more than 200 passengers each, the total number of passengers is not less than 1,314,000,000 per annum. This would give every inhabitant of the United States about 20 car rides a year.

Evidently street railway work is rapidly assuming gigantic proportions, and as it grows it opens up a larger and larger area for electrical engineering and electrical productions.

COST OF ARC LAMP TRIMMING.

One of the regular items of expense in operating an arc station is that of lamp trimming. As a general rule, and perhaps universally, the carbon trimmers are paid at the rate of about $2 per day, and each man has so many lamps assigned to his care. The general manager of a large plant in the Southwest informs us, however, that he has tried the performance of trimming duty on a piece-work basis. At first they paid their trimmers 2½ cents per lamp, so that the men made as much as $75 to $90 per month, although the circuits are very long. Since the middle of May, they have reduced the rate to 2 cents per lamp, the men still making as much as $65 per month. Each man, it will be seen, looks after more than 100 lamps per day.

A disadvantage of this method is that the men are hardly likely to take time to give the lamps the care they require, the trimmer being more anxious as to the number of the lamps than as to their efficient burning. On the other hand, the men, since they get so much for each lamp on their "beat," are anxious to secure new customers, and will readily go out of their way to secure additional business for the station. We think the subject an interesting one, and would be glad to have other data or expressions of opinion from our readers.

CHEAP CONTRACT WORK.

There is no denying the fact that cheap and dishonest competition has cut much of the interior wiring business into pieces, so that reputable contractors often do not care to bid on work. It is true the lighting wires are subject to inspection, but the rates asked are so low sometimes that one knows immediately that, inspection or no inspection, either the purchaser will "get left" or the contractor will shoulder a heavy loss. In ordinary work for bells, annunciators, alarms, etc., where conscience is not kept on the alert even by fear of the inspector, the work is frequently disgraceful. If it were plumbing, the architect knows that he would have to deal with a board of health

or with a nervous buyer whose sense of smell had been abnormally developed by the reading of sensational hygienic literature. But wiring—the lowest bid will win the day. This is not as it should be, and until architects are themselves able to judge of the quality of the work and of the goods used in the installation, they should call in a trustworthy expert or engineer, whose modest fee for examination will be recouped many times over in the solid satisfaction enjoyed by the occupants of the property. The subject is one of general interest to the electrical profession. There is certainly room for better work, and better prices for it, and the effort should be made to raise the standard in both respects.

LIGHTNING PROTECTION.

THERE is perhaps no more anxious time for the central station manager than when he sees a thunder storm approaching, with the consciousness that the entrance of lightning into the station may ruin part of his machinery, if it goes no further to entail more serious destruction. The lightning protection of central stations has in fact been the constant study of not a few electricians and inventors of eminence, and that there is still room for study and improvement is evidenced by the frequent appearance of new devices designed with this object in view. Quite recently our columns have contained descriptions of apparatus of this nature in which the object aimed at was the elimination of all self-inductive resistance from the circuit on the one hand, in order to present no obstacle to the path of the oscillating discharge; while, on the other hand, we described a device in which self-inductive resistances were purposely inserted in order to force the discharge to take an easier path to earth. In our last issue we presented another modification, in which the purpose aimed at is not only to eliminate all self-induction, but all non-inductive resistance as well. Mr. Holcombe, it will have been noted, has accomplished this by the connecting to the line direct a device possessing a potential of its own in opposition to that of the line, but offering little or no resistance to the passage of a lightning discharge.

Small Arc Lamps.

WHILE at the outset arc lamps were employed to a considerable extent for interior illumination, their use is at the present time confined almost exclusively to outdoor illumination except in cases where large interior spaces are to be lighted, and where the height of the ceilings permits of the even distribution of the light. It has often been remarked, however, that an arc lamp of small candle power ought to find a large field for application for interior illumination, and it is indeed strange that efforts in the past have not been made or have not been successful, if made, to produce a lamp of this nature. We believe that some attempts, with fair success, have been made abroad, but up to the present this field seems to have been entirely neglected in this country. We are glad to note, therefore, the appearance of a lamp designed for such a purpose, and which we describe in another column. With good mechanism and good carbons, so as to insure a steady light equivalent to 150 or 200 candle power illumination, there is no reason why such a lamp should not come into extensive use, especially on the score of economy.

Electric Metal Working.

Now that electric welding, pure and simple, has attained a firm foothold in the arts, we see springing up around it, and as a direct result of it, a variety of most valuable and interesting processes worked out by Prof. Thomson and his associates. Among these we describe in this issue a process for case-hardening, devised by Prof. Thomson, in which the high heat produced by the current is employed to effect the deposition of carbon from a hydro-carbon gas surrounding the piece to be treated. This process will be recognized at once as analogous to that employed for the flashing of incandescent lamps in order to obtain uniformity in the filament. In the present instance, however, the body upon which it is deposited combines with the carbon to form a steel coating. Mr. Lemp's process of electric swaging seems also destined to a wide application, not only on account of the nicety with which the operation can be performed, but equally on the score of its economy. It is safe to say that we have by no means reached the end in this work, which indeed seems without limit.

Developing the Phonograph.

A BRIEF article elsewhere in our pages gives a few interesting details as to the later development of the phonograph. It appears that 8,000 phonograph or graphophone machines are now in use, and that the number is rapidly increasing, as it is likely to do when a single firm finds employment for as many as 16. After ten or twelve years of telephonic exploitation, there are well over 400,000 telephones in use, and since the newcomer will prove far more generally serviceable, there is no reason for doubting that after a like period not many short of a million phonographs will be at work. The phonograph is a much simpler piece of apparatus to master and run than the sewing machine, and of its immense convenience we can speak from personal knowledge and experience. A feature that gives it special interest to electrical people is its dependence upon electricity as a motive power. Not a little ingenuity has already been shown in supplying motors and batteries for its operation, and it is obvious that further uses for electricity will be found as new fields for the phonograph are opened up.

Mercury Thermal Cut-Outs.

As a method of protection from abnormal currents, fusible cut-outs have found wide application, probably as much on account of their simplicity as for any other reason. When applied to the protection of delicate instruments, however, the difficulties encountered in drawing down a fusible metal, on account of its lack of tenacity, and also from its extreme fragility, limit its use. To avoid this, Mr. Stephen D. Field has applied the mercury cut-out in an ingenious manner, by which not only is uniformity and strength obtained, but the cut-out is saved from destruction, and, upon the cessation of the abnormal current, immediately assumes its former guarding functions. The cut-out shows itself to be quite satisfactory in its operation under severe conditions.

THE RIES ELECTRIC TRACTION-INCREASING SYSTEM.

We have recently devoted considerable space to the discussion of the increased adhesive effect produced between driving wheels and rails and other metallic surfaces when traversed by an electric current under given conditions. Among the contributions upon this interesting subject, we have had the pleasure of describing in detail[1] the important results obtained by Mr. Elias E. Ries, during a series of original investigations and experiments extending over a considerable period, in the direction of applying this method of increasing tractive adhesion to steam and electric railway locomotives.

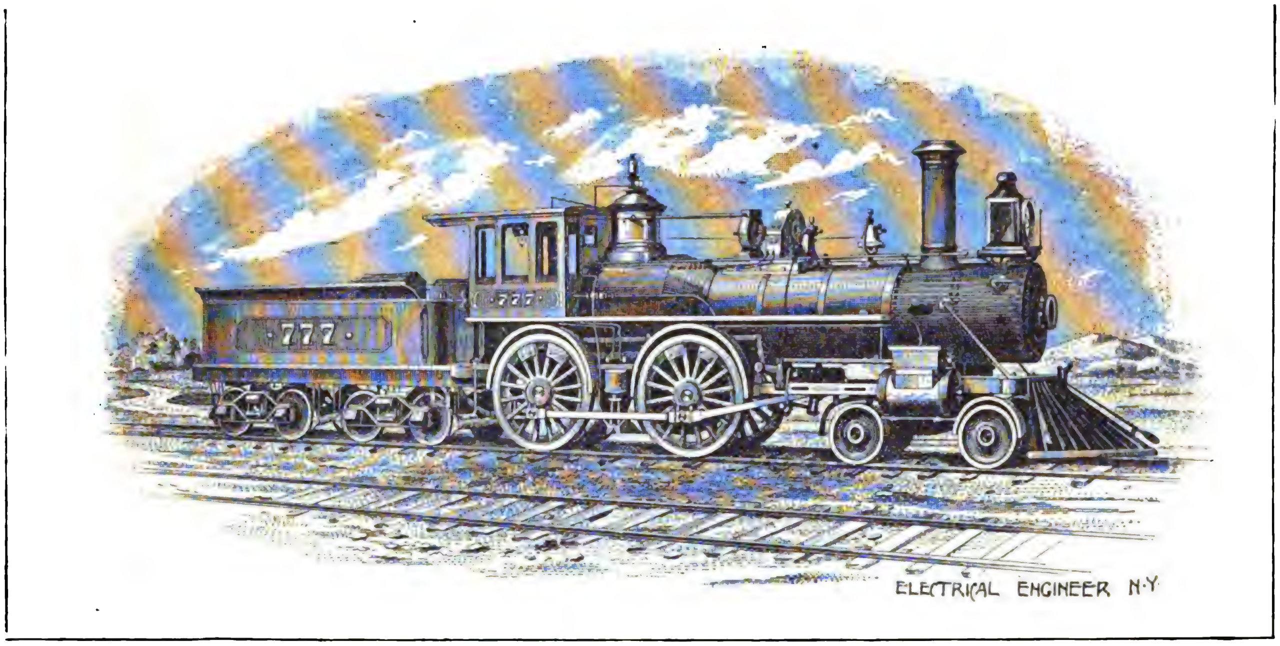
It will be remembered that in this system of electrically increasing traction as developed and practiced by Mr. Ries, a low tension quantity current is made to flow through a local circuit of almost negligible resistance, of which circuit the driving wheels and that portion of the track rails immediately below and between them form the principal part. This current produces a slight local heating or incipient welding effect at the points of contact between the wheels and rails, which is practically instantaneous in its action, and brings about a decided increase in the coefficient of friction between the opposing metallic surfaces.

Practical interest in the subject has recently been awakened among railway men by the exhibition of working models of this invention at the annual meetings of the Association of Railway Telegraph Superintendents[2], and of the American Railway Master Mechanics Association[3], held at Niagara Falls, N. Y., and at Old Point Comfort, Va., respectively, on June 18 and 19, 1890, at which the new method of increasing tractive adhesion met with considerable favor, the models exhibited showing an increase in traction due to the current of over 200 per cent. Preliminary tests of the invention, as applied to steam locomotives in regular service, have been very successful, and this, together with the favorable reports of experienced railroad officials who have investigated the system, has recently led to the organization, in Baltimore, Md., of the Ries Electric Traction and Brake Co., with a capital stock of $2,000,000, for the purpose of further developing and introducing the same.

1. The Electrical Engineer, June 4, 1890, page 432.
2. The Electrical Engineer, June 25, 1890, p. 511.
3. The Electrical Engineer, July 2, 1890, p. 18.

We are enabled this week to present to our readers, through the kindness of this company, a perspective view showing the general appearance of a steam passenger locomotive equipped with their electric traction-increasing apparatus, and we hope soon to be able to make public the results of the new series of tests that we understand are now in progress on the Baltimore and Ohio Railroad.

Referring to our illustration, it will be seen that the traction-increasing current is generated by a small alternating current dynamo driven by a rotary engine supplied with steam from the locomotive boiler. The engine and dynamo are mounted upon a common base secured to the boiler in the position formerly occupied by the sand box. One or both pairs of driving wheels are electrically insulated from the body of the locomotive and from each other by the use of special insulation surrounding the driving box and side rod brasses. The insulation so far employed has proven itself fully capable of withstanding the exceptionally severe strain to which it is subjected, and tests made after several months of continuous service have led to its permanent adoption for this class of work.



The Ries Electric Traction-Increasing System.

Electrical connection with the two pairs of drivers is maintained by means of peculiarly constructed brushes bearing upon brass sleeves secured to the central portion of each driving axle. These brushes are connected, by means of heavy stranded copper conductors, with the source of low tension current, which in the case illustrated is a transformer (not shown) placed in proximity to the main driving axle. A type of machine is now about to be used, however, which generates directly the low tension quantity currents required. As the resistance of the traction-increasing circuit is practically constant under given track conditions, the flow of current is usually regulated by varying the electro-motive force, which, on account of the low resistance of the circuit and multiple connection of the driving wheels, can be kept very low. The current density at the points of contact between the driving wheels and rails can be varied at will, according to the percentage of increased adhesion desired, the usual range being from 500 to 2,500 amperes.

It is proposed to use part of the current generated by the dynamo, either directly or indirectly, according to the type of machine employed, for the operation of electric locomotive and train brakes, electric headlight and train lighting, etc., in addition to its use for increasing traction. The dynamo is generally kept running at a slow rate of

speed when not otherwise employed, and is so constructed as to respond promptly and automatically to any demand that may be made upon it within the limits of its capacity.

Experiments already made upon a large scale have shown that by this method it is possible to increase the tractive adhesion of locomotives fully 25 per cent., thus enabling them, with a saving of fuel, to haul a largely increased load, to mount heavier grades, and to descend the same under perfect control and without the skidding of wheels. Besides this, it will enable railroads to haul, with their present engines, much longer trains than they can now do, thus not only increasing the carrying capacity of the road, but saving largely the wear and tear upon tracks and bridges that the use of heavier engines for this purpose would entail. It will likewise enable both passenger and freight locomotives to make better speed and to maintain schedule time notwithstanding ordinary unfavorable conditions of the track due to the weather.

A recent report of a large railway shows that an increase of *one-fifth of one car* per train brought an increased revenue of over $50,000 in six months. It is needless to say, therefore, that if the claims made by the Ries Electric Traction and Brake Co. for their traction-increasing system are even partially realized in practice—and the experiments already made by Mr. Ries go to indicate that these claims are entirely within the mark—the increased earnings to railroads from the use of this invention would be simply enormous, to say nothing of the operating and other advantages to both steam and electric railways that would result from its adoption.

McDOUGALL'S ELECTRIC CAR MOTOR.

In our last issue we described the electric car now being constructed by the McDougall Electric Co., after designs by Mr. Wm. M. McDougall. The latter gentleman has, however, devised still other means of construction, and among them is one in which the motor revolves with the

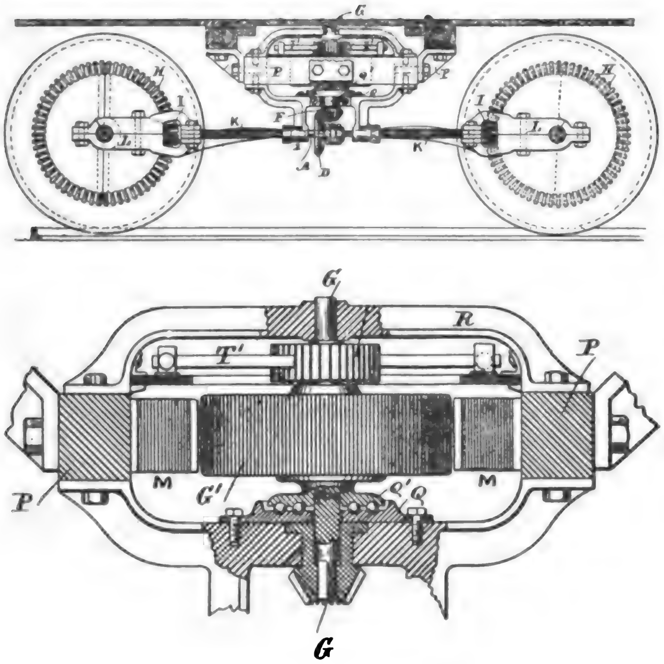
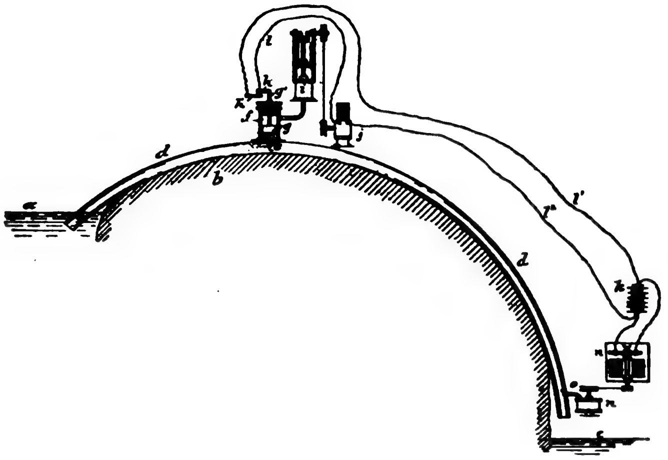


Fig. 1.—McDougall Electric Car.

shaft placed vertically and connected to the axles by bevel gear. The manner in which this is carried out is shown in the accompanying engraving, Fig. 1, which shows a side elevation of the car truck, Fig. 2 showing the motor enlarged and in section. As shown, the shaft K is coupled to the short shaft A, supported by bearings upon the frame of the motor and between these bearings is the bevel gear D meshing with the pinion F. The bevel gear-wheel D and sleeve are slipped endwise upon the shaft A by lever and fork, and when the wheel D is in contact with the pinion F the car will be propelled.

The motor is provided with field-magnets M, supported by the main frame P of the machine and the beams of the car. The armature-shaft G passes into the pinion F, and in order to allow the armature and shaft to be lifted out, a square or key is placed at the lower end of the shaft to connect the same to the pinion F, and this pinion has a tubular hub



The Electric Siphon.

and flange within the frame for holding the pinion in position when the armature-shaft is withdrawn.

In order to lessen the friction Mr. McDougall makes use of a concentrically grooved plate Q, and a similar plate Q′, fastened upon the armature-shaft with steel balls in the concentric grooves for supporting the weight of the armature. The upper end of the armature-shaft is supported by a removable cross-bridge R, bolted to the main frame, and having a central bearing for the armature-shaft, so that the armature can be lifted out when this bridge is unbolted and removed, and to facilitate this operation a trap is provided in the floor of the car, so that by lifting or swinging the same inside access is given to the motor. The commutator and brushes being at the upper end of the motor, are easy of access for cleaning or repairs by simply lifting the trap.

AN ELECTRIC SIPHON.

The application of the siphon for the conveyance of liquids from a higher to a lower level is an old one, but when it is attempted to apply it on a large scale difficulties are encountered due to the accumulation of air in the upper end of the siphon, which stops the flow. In order to avoid this, Mr. George W. Bailey, of Brooklyn, N. Y., has recently devised a method which is illustrated in the accompanying engraving. Here the siphon pipe *d* dips at one end into the water *a* and extends upward over the bank and downward to the lower level *c*. *e* is a hole connecting the interior of the pipe at the top of the bend with chamber *f*. Within this chamber is placed a float *g*, which is connected by the stem *g′*, with one of two electrical contact points *h h′*, so that when the float *g* falls the contact will be made between these points, and when the float *g* is raised the contact will be broken. *i* is an air pump arranged to exhaust air from the bend of the siphon-pipe and *j* is an electric motor arranged to drive the air pump.

A storage battery *k*, is connected with the electric motor by the wires *l l′ l″*, so that when the current is closed in those wires the electric motor *j* will be operated to drive the air pump so as to exhaust the air from the bend of the siphon. The wires *l* and *l′* are connected, respectively, with the contact points *h* and *h′*. Current is generated by means of a dynamo machine *m*, driven by a turbine wheel *n*. The water for driving this turbine wheel is taken near

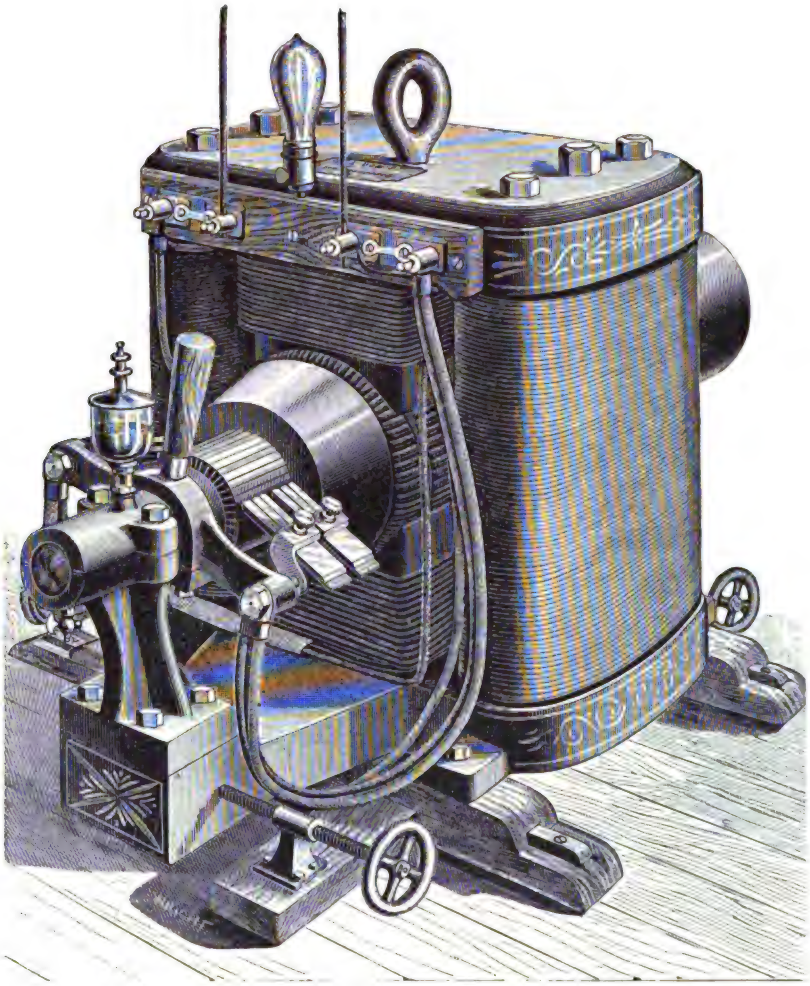
the lower end of the siphon pipe from the stream of water falling within, the siphon pipe *d* being tapped by a branch pipe *o*, leading to the turbine for that purpose.

The operation will now be readily understood :—When the siphon pipe is in perfect operation, the water will rise up in the chamber *f* sufficiently to raise the float *g* and break the current of electricity by separating the contact points *h* and *h'*. Under these circumstances there will be no current to drive the electric motor *j*, and consequently the air pump will not operate. As fast as any air accumulates in the bend of the siphon pipe, it will rise up into the chamber *f*, and the level of the water will fall therein until the float has descended far enough to bring the contact points *h* and *h'* together, so as to close the current. This will start the electric motor *j* in operation so as to drive the air pump and exhaust the air from the chamber *f*. This operation will continue until the air has been exhausted sufficiently to raise the level of the water and with it the float, so as to separate the contact points *h* and *h'*. In this manner the air pump and electric motor will be required to operate only to a very slight degree, in order to keep the bend of the siphon free from the accumulation of air. At the same time an ample charge will be maintained in the storage battery *k* by the continuous operation of the turbine *n* and dynamo *m*.

Mr. Bailey believes that with an arrangement similar to that described above, many natural waterfalls might be availed of for power, in many cases where sluices or tunneling would either be impracticable, or too expensive, especially as natural waterfalls usually occur in rocky places, where the conditions that are unfavorable to almost every other agency, still admit of the use of electricity.

THE LOOMIS INCANDESCENT DYNAMO.

Constancy of potential on incandescent circuits has long been recognized to be essential to long life in incandescent lamps, and dynamo builders have made this quality in their machines subservient to almost every other. To attain this object—that is, constant potential at varying loads—the Eureka Electric Company, of this city, have brought out a machine designed by their electrician, Mr. O. P. Loomis, in which compound winding is applied in a most effective way. The machine, which is illustrated in the accompanying engraving, is of the consequent pole type, but instead of following the usual practice in compound wound machines, Mr. Loomis places the series coils directly upon the pole pieces. In this way their action is intensified by their being brought as close as possible to the armature. Another feature of the series coil is, that a wide copper strip is employed instead of wire, the object being to obtain as low a resistance as possible. Mr. Loomis finds that the winding and insulation of such a copper strip can be very easily performed and that it is quite as economical as copper wire, as regards cost, if not more so. The latter would have to be very heavy to carry the current and the turning of the corners would involve difficulties which are absent in the copper strip.



The Loomis Incandescent Dynamo.

The result of the compounding is that the potential of the machine remains practically constant between full load and one lamp, as we had occasion to note in a recent trial.

The machines are built in sizes varying in capacity from 25 lamps to 750. The 600 light machine has a current output of 400 amperes, and its armature is wound with a cable consisting of seven No. 10 wires, and having a re-

sistance of .009 ohm. This cable is in one continuous length and tapped by copper strips connected with the commutator. The shunt coils consist each of twelve layers of No. 10 wire and have a resistance of 19.5 ohms. The series coils consist of 6 turns of copper strip .065 inch thick and 5 inches wide, wound on each pole piece, and have a combined resistance of 0.0013 ohm. The machine is designed to give 110 volts at 950 revolutions, and weighs 5,600 pounds. All the mechanical as well as the electrical details have been well worked out, and the machine presents a very neat and compact appearance.

ARC CIGAR LIGHTER AND TABLE LAMP.

The convenience and cleanliness accompanying the application of the electric current for heating purposes has already found many uses for it, among which the electric cigar lighter is now a familiar object in many cities. Heretofore this class of apparatus has embodied a construction involving the heating of platinum or german silver wires, but a departure in this respect has recently been made by the substitution of the arc light. This has been carried out very neatly in apparatus shown in the accompanying engraving. The cigar lighter consists in fact of a small arc lamp, the mechanism of which is hidden in the ornamental base. By pressing the button shown, the arc is started, and the mere application of the cigar end at the arc serves to light it uniformly. The lamp consumes only half an ampere of current at an E. M. F. of 50 volts—that is, the electric engery equivalent to an incandescent lamp, and as it is lighted intermittently, the cost for current is but trifling, not exceeding, it is claimed, 15 cents a month; while the avoidance of all burnt matches, the trimming of lamps and other cigar-lighting devices gives it a distinct value. The lamp is adapted for both

An Arc Cigar Lighter and Table Lamp.

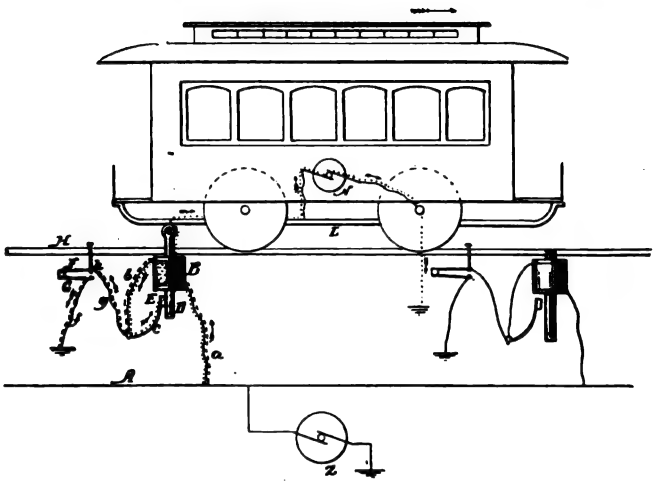
continuous and alternating and for arc or incandescent circuits. The carbons are calculated to last one month with ordinary use.

The lamp can be readily transformed into a table lamp for the studio, drawing-room or office, with the addition of an ornamental shade. It gives a light equal to 180 candle power, equivalent to more than ten 16 c. p. lamps, the light being of a pure white. The renewal of the carbons involves but a slight and infrequent expense, while the economy of the arc light per unit of current energy makes it very economical. This interesting novelty is manufactured by Messrs. Schefbauer & Co., of Paterson, N. J., and is being introduced by the E. P. Gleason Manufacturing Co., of this city, who have one on exhibition—the first that has been shown in public.

BLICKENSDERFER'S ELECTRIC RAILWAY SYSTEM.

While the ingenuity of many inventors is still being employed in the perfection of the details of overhead railway construction, not a few are at work on the solution of the best method of conduit construction for the reception of the conductors. Among the methods proposed are several in which avoidance of the slot has been a leading feature, and a recent plan with this object in view is that proposed by Mr. U. Blickensderfer, of Chicago.

The manner in which this is carried out is shown in the accompanying illustration, the general idea being to have



The Blickensderfer Electric Railway System.

a constant contact with the buried insulated conductor by making, as it were, a trolley of the car itself.

Contact with the moving car, whereby the motive current is conducted or transmitted to the car and its motor, is made by first flashing a temporary starting current through each helix or solenoid coil B, as the car advances, which raises the movable core D, till it comes in contact with the flat conductor-bar L placed longitudinally under the car. The initial, or starting current, therefore, is a temporary current. Its course or circuit is shown by a line of dashes in the engraving.

As the car wheel depresses each pin-head H, it brings the springs F and G together at *h*, which completes a circuit for the initial current, viz., from the main buried conductor A, through the solenoid coil B to the ground, for the return current.

The initial current flows only while the car wheel is treading each pin-head down, in passing. It is, therefore, but temporarily in action, its purpose being merely to raise each forward core before the car conductor-bar leaves the rearward core contact. But the instant the initial current flows, and raises the soft iron core D, it also magnetizes it; and then by virtue of its imparted magnetism, the core D in turn attracts the soft iron piece E, purposely placed on the end of the spring *c*, and draws the spring over till it touches at E the core D at its lower end. It thus completes a circuit for the motive current, viz., from the main buried conductor wire A, through the solenoid coil B, the spring *c*, core D, car conductor-bar L, and motor N, to ground. The course of the motive current is shown by the dotted lines.

As the motive current, after being put in circuit and action by the initial current, passes from the main A, by the wire *a*, first through the helix of the core D, and thence through the core, conductor-bar, car motor, etc., it takes the place of the temporary initial current in keeping the core raised, after the temporary current has flashed or performed its brief part, and then ceased. The motive current, therefore, by virtue of its course, continues to keep the core elevated to a contact with the car conductor-bar, as the car moves forward, and until it has passed by; and so on.

By the construction adopted the slot is avoided and no shock can be obtained by persons or animals passing, since the core bolts D are "dead," electrically, except when the car is over them.

THE WALKER ELECTRIC METER.

OUR readers will remember that in a recent issue[1] we described the electric meter designed by Mr. G. W. Walker, of the Walker Electric Co., this city. This apparatus, it will be remembered, is so constructed that the current strength is, as it were, continuously photographed, so that all disturbances or irregularities due to friction in the apparatus, were a mechanical marker employed, are done away with. Since our description above referred to has appeared, Mr. Walker has entirely remodeled his meter, though not altering the principle, but resulting in a simplification and re-arrangement of the parts, which considerably increase its efficiency.

The improved meter, as it appears at present, is shown in the accompanying engraving, Fig. 1, with the cover removed. As will be seen, it consists of an ammeter coil in the shape of a solenoid, in which an iron wire in the shape of a nearly complete circle is placed as a core; to the same shaft to which the circle or core of the armature is attached there is also fixed a light aluminum sector, provided with a fine vertical slot, and immediately behind

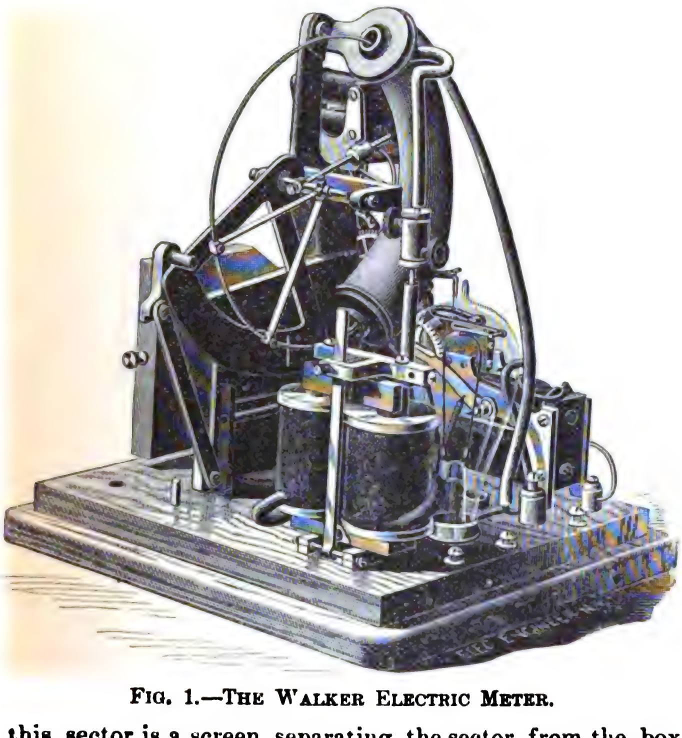


FIG. 1.—THE WALKER ELECTRIC METER.

this sector is a screen, separating the sector from the box which encloses a roll of sensitized photographic paper.

The interior of this box is shown enlarged in the engraving, Fig. 2. The screen before the box containing the sensitized paper has a horizontal slot, which permits the light from an incandescent lamp to fall upon the paper so as to form the line of light, J. Besides this there is a series of perforations in the screen, which permit the light to enter and form the dots, I, shown. The vertical slot in the sector is arranged to come immediately in front of a second horizontal slot in the screen, so that in whatever position it may be it will allow a ray of light to pass from the lamp and throw a single dot, H, upon the sensitized paper.

In this way it will be evident that, depending upon the strength of the current passing through the solenoid, the sector will take up a corresponding position which will be indicated by the impression made by the ray of light upon the moving paper. The varying position of the dot traces a curve which will be further away from the end of the box as the current is increased. The perforations forming the dots, I, shown, will cause a corresponding number of lines to be photographed on the paper, and these perforations are so spaced that the distance between two consecutive lines represents two amperes of current.

The slot which forms the horizontal line, J, is normally closed, but at intervals of one hour it is opened for a fraction of a minute so as to allow the line, J, to be photographed, and in this way the time record is obtained; the space between the successive lines, J, representing hours, are half an inch apart, and the curve formed by the moving dot of light, H, indicates continuously the ampere strength.

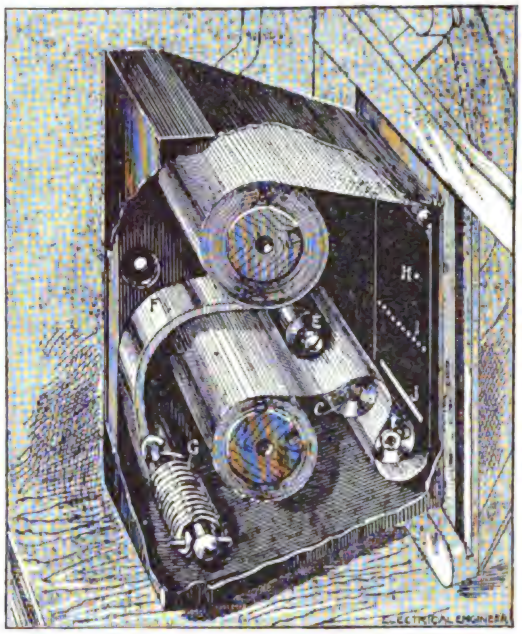


FIG. 2.—THE WALKER ELECTRIC METER.

It is evident, however, that some means must be provided for causing a continuous movement of the paper roll, and this is effected by means of a small clock movement which is wound automatically by the small electro-magnet shown in Fig. 1.

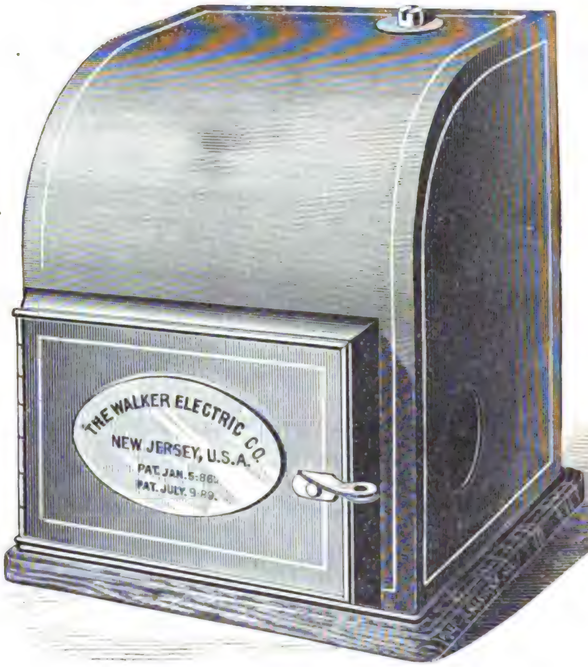


FIG. 3.—THE WALKER ELECTRIC METER.

The full roll of paper, it will be noticed, is mounted upon

1. THE ELECTRICAL ENGINEER, April 9, 1890.

a spindle, A, and after passing before the perforated screen passes to the receiving spindle, B. It is held taut by the roller, E, which is mounted on the arm, F, provided with a spring, G. By turning back the arm, F, the roll of paper can be easily slipped out and a new roll inserted. When no current is on, the meter is at rest, but the lighting of a single lamp immediately sends a current through the relay and photographing lamp shown in Fig. 1, which also starts a clock movement in operation that revolves the paper before the screen. A roll of paper sufficient to last one month may be placed in the box, after which time it is taken out and developed in the ordinary way.

The curve indicated on the chart can be readily measured up in the same way as a steam engine indicator diagram, so that practically no calculation is required to ascertain the number of ampere hours.

We have seen the Walker meter in operation, and the results obtained with it are very satisfactory. The engraving, Fig. 3, shows the meter covered completely and occupying a space of about one square foot.

CONVERTERS WITH CORES OF IRON FILINGS.

THE pernicious effects due to the generation of Foucault currents in the armatures of dynamo machines very soon led to their lamination, and the introduction of converters brought out still more prominently the necessity for the subdivision of the iron when subjected to changing magnetic conditions.

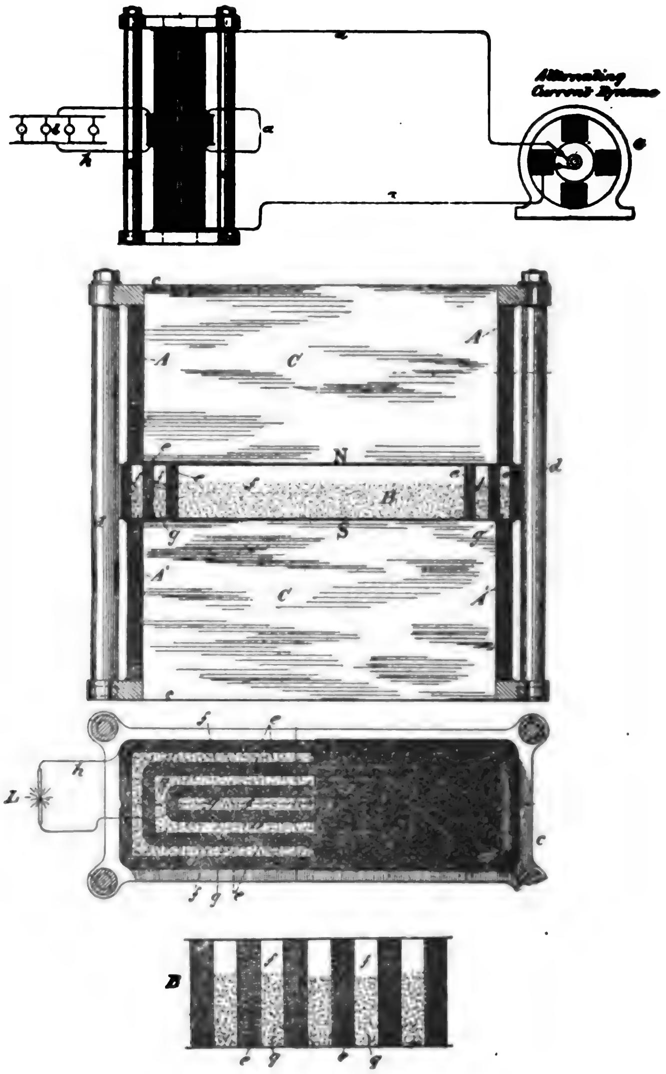
In carrying out still further the lamination or subdivision of the core, Mr. De Castro, of this city, has adopted a method, which is the subject of a recent patent, and which consists in the employment of iron filings, arranged in such way as to be loose or free to move, so that the particles may vibrate and be subjected to the action of magnetic lines of force derived from electro-magnets or from an exciting coil. The field of force in which the iron filings are thus placed is a varying field of rapidly-alternating polarity, which sets the mass of iron filings into rapid motion or vibration. The coils are arranged within inductive proximity to the vibrating mass of filings, and are influenced thereby for the induction of alternating currents.

The manner in which Mr. De Castro has carried out this idea is illustrated in the accompanying engravings, Fig. 1 showing the general arrangement and Figs. 2, 3 and 4 being views of the converter employed.

The coils, A A′, are the field or exciting coils, being included in a circuit, *a a*, and fed by an alternating-current dynamo. The coils are fitted with soft-iron cores, C C, laminated, as shown in Fig. 3, by being built up of plates of soft iron and clamped in to iron top and bottom plates, *c c*. They are arranged with their opposite polar ends, N S, facing one another and spaced sufficiently apart to make room between them for an armature or inductor, B, which consists of a coil arranged to be traversed by the lines of force induced by the coils, A A′. The outer ends or poles of the field-magnets are connected together to form a closed magnetic circuit through the medium of the posts, *d d*, which also form a mechanical connection between the top and bottom plates, *c c*, by which the whole structure is solidly united.

The inductor, B, as shown in Figs. 2, 3 and 4, is built up of two or more coils, *e e*, and intervening spaces, *f f*, the latter being closed at the top and bottom by plates of vulcanite, mica, or other non-magnetic substance. These spaces are partly filled with masses of iron filings, *g g*, which should be sufficient to about two-thirds fill the spaces or chambers.

In a state of rest the iron filings are held by gravity in the lower portions of the chambers, as shown in Fig. 4, the upper portions being empty. If now an alternating current be sent through the coils, A A′, thereby magnetizing their cores, the iron filings which are subjected to this rapidly-alternating field are set into active vibration. Their bodily movement is back and forth in one mass, or the mass may divide and its two portions may fly toward the opposite poles during one phase of the pulsation, and during the succeeding phase they may fall back toward the centre of the space, their vibration thus taking place toward and from the centre in two masses. In so doing each of the separate particles, being magnetized by induction, has the effect of a separate minute magnet moving through the coils, *e e*, and hence these coils, in addition to being excited by the mere projection of the lines of force from the magnets, A A′, through them, are further inductively affected by the bodily movement of the magnetic particles of iron



FIGS. 1, 2, 3 AND 4.—CONVERTERS WITH IRON FILINGS.

to the same effect as though so many separate small magnets were quickly moved into the coils.

The same idea has been applied by Mr. De Castro in the construction of the cores of dynamos, and experiments which he has made lead him to believe that by the employment of cores of subdivided iron or iron filings in lieu of solid cores, he can secure inductive effects of much greater intensity than heretofore and effect a considerable economy of electric energy and insure the conversion of a greater number of lines of force or energy than has heretofore been possible.

THE FRENCH CABLE.

The French Cable Co. is increasing its capital from 5½ to 11 million francs, and stock subscription books have been opened in Amsterdam, Brussels and Paris.

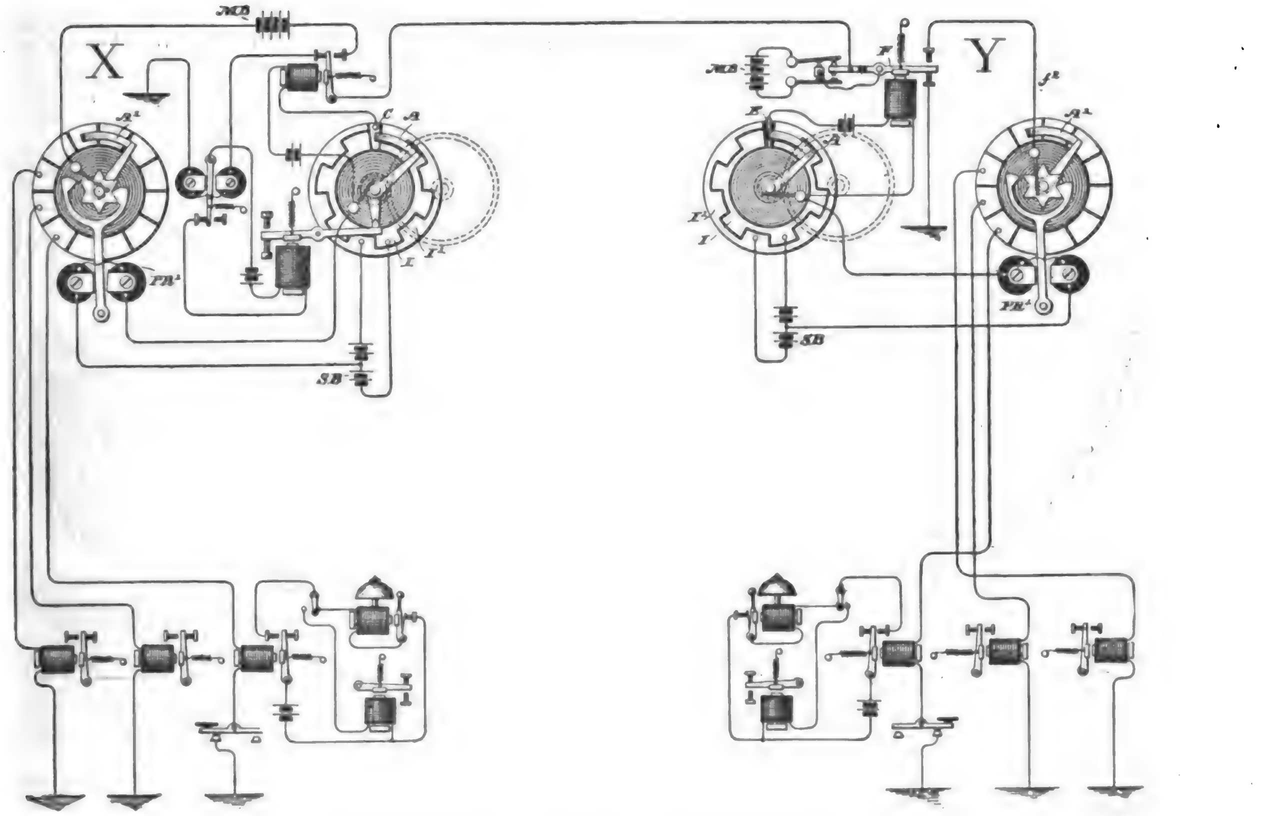
DELANY'S SYSTEM OF PRIVATE LINE TELEGRAPHY.

The necessity of having direct and rapid communication between correspondents in different cities some time since created the "private line," the use of which is constantly increasing among business firms. The heavy expense involved in this method where but one subscriber is at each end of the line has somewhat restricted the use of this method, and recognizing the need of some arrangement by which a line could be automatically distributed to a number of subscribers at stated intervals, Mr. Patrick B. Delany has recently patented a system adapted to both telegraph and telephone circuits. It appears to us that this idea, practically worked out, as it is, must supply a necessity now rapidly developing, and to meet which the Long Distance Telephone Company have already resorted to a system of hand transferring of lines simultaneously at both ends for such of their subscribers as do not require constant facilities.

Mr. Delany's system, which we illustrate in this issue, comprises an ingenious and effectual system of automatic switching controlled by a clock at each end of the line. It is so arranged that subscribers at distant points may be put in communication for five, ten, fifteen, twenty, thirty or more minutes in each hour. A New York subscriber having a branch house or correspondent in Boston, may, at a fixed yearly rental, subscribe for a line for five minutes in each hour throughout each day. Another pair of subscribers may arrange for ten minutes in each hour, or for five minutes in every half hour. Another pair may be accommodated with fifteen minutes each hour, and so on, until the whole time of the line is taken up. Thus a single line passed around periodically may be made to give ample facilities to a number of firms at a comparatively small cost to each. Very many concerns whose business does not warrant an exclusive wire will be attracted to a service which will give them just such facilities as they require, and relieve them from paying for more than they can use. This automatic system not only obviates the employment of switchmen, but insures decidedly more reliable and accurate distribution of the line, since the clocks are automatically regulated each hour, so that the transfer from one pair of subscribers to another must be simultaneous.

An important feature of the system is the elimination of the clocks from the main circuit, except during the one minute in each hour applied to their automatic correction. Thus there are no moving or scraping contacts in the circuit, and, furthermore, the clocks cannot be affected by any disarrangement of the wire. The automatic cutting in, correction, and cutting out of the clocks each hour is very ingenious and renders the rest of the operation quite simple.

At station X the trailer A carried by the clock mechanism is shown as resting on the correction-receiving segment C. From this segment a line runs through the neutral relay and local battery and back to the trailer. The neutral relay is therefore closed and the main line, which is connected to the armature, is grounded through its front post and the polarized relay. While in this position the main line is disconnected from the subscribers. Now, with the trailer at Y touching the small blade A, current from the positive pole of the main battery M. B. at Y energizes the polarized relay at X, drawing its armature against the tension of the biassing spring and closing the local circuit of the setting or correcting magnet of the clock at X.



Delany's System of Private Line Telegraphy.

On the end of the lever of this magnet is a wedge-shaped piece which, when the armature is drawn down to the magnet, enters a corresponding notch in the arm attached to the trailer shaft, and sets the trailer exactly in the centre of the correcting segment, or in a position corresponding to the thin segment over which the trailer at Y is passing, and from which the correcting impulse is being sent out. The sending correcting segment at Y is but about one-tenth the size of the segment for the reception of corrections at X. The latter represents one-sixtieth of

the circle, as the trailer is exactly one minute in passing over it.

The sending correction segment represents about five seconds; therefore, the clock at X may be half a minute slower or half a minute faster than the clock at Y and still be within the scope of correction from the small segment at Y.

Should the trailer at X reach the correcting segment before the trailer at Y reaches the small correction segment, no correction can be received at X from the operating battery at Y, which is normally on the line, for the reason that this battery attracts the armature of the polarized relay in the direction in which the spring is pulling it. Not until the trailer at Y reaches the small segment and closes the local circuit of the *pole changer*, putting the negative pole of the main battery M. B. to the line, will the polarized relay at X be affected. As soon as the trailer at Y passes off of the small segment the local circuit of the pole changer is broken, the positive pole of the main battery is restored to the line, and at the instant that the trailer at Y passes off of the insulation represented by the black line, the trailer at X passes off of the receiving segments for corrections, and the line is given to each of the first pair of subscribers exactly at the same instant.

The switching, or simultaneous transfer of the line, is accomplished in the following manner: The circuit table of the clocks comprises two parts or rings, with six projections on each, and brought together in alternately interlocking position, so that the twelve teeth or projections lie in the track of the trailing finger. The trailer corresponds to the minute hand of the clock. The projections represent five minutes each, because it takes the trailer five minutes to pass over one. The set, I, is connected to the negative pole of the split battery, S B, the other set, I^1, being connected to the positive pole of the same battery. This battery works the polarized switching instruments, P R^1. The main line is normally connected to the trailing finger, A^1, of these polarized switching instruments. There are twelve separate segments in the circuit table of these instruments. If there were twelve subscribers wanting five minutes facilities in each hour, each would be connected to one of these segments. The one minute appropriated to the correction may be taken from the last or first subscriber, and allowance made in his rental for the same.

In the diagram the trailers of the clocks are shown at unison, and the trailers of the switching instruments are on the segments of the last subscriber. When the clock trailers pass to the first projection of plate I^1, the batteries of the polarized switching instruments, P R^1, will be reversed, and the trailers connected to the main line are moved to the next pair of subscribers by the movement of the pawled armature levers. When, at the end of five minutes, the clock trailers reach a tooth on plate I, the batteries of the polarized switching instrument are again reversed, and the line is transferred to the next pair of subscribers, and so the transfer goes on regularly so long as the clock is wound up every eight days. It will be seen that the transfer of the line is made simultaneously and with a snap, and that the main line contact is quiet until the time expires. Any portion of an hour may be given to any pair of subscribers by simply connecting the subscriber's branch line to the number of segments required. The branch lines to the subscribers are normally switched to a vibrating bell, so that when the circuit comes on, the operator's attention may be attracted and no time lost.

NOISELESS GEARS FOR ELECTRIC CARS.

THE method of transmitting the power of the motor to the axles of electric cars has absorbed probably as much attention as any other detail of electric car construction. In the method now generally in use, owing to the high speed of the armature, it is customary to use a small pinion, and at least one counter-shaft between the armature and the large gear on the axle, in order to get the desired reduction in the number of revolutions of the car wheel. These gears and pinions are subjected to very heavy duty and, in addition, are exposed to dust and dirt, which, in comparatively short time, necessitates their renewal, involving considerable expense. In order to avoid this, and at the same time to provide a noiseless gear, Messrs. Chadbourne, Hazelton & Co., general agents for the Wenstrom Consolidated Dynamo and Motor Co., have recently brought out an interchangeable elastic gear which possesses a number of novel features.

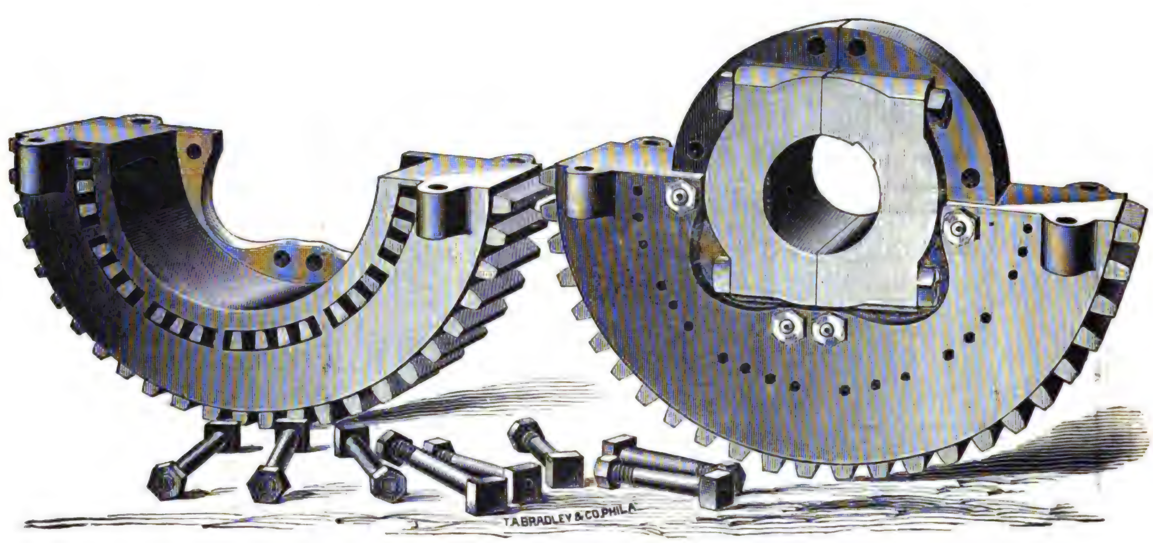


FIG. 3.—SPLIT AXLE GEAR, SHOWING HUB AND SECTION OF COGGED RIM REMOVED.

The manufacturers of this gear have started out on the principle that contrary to the present practice, where one of the gear wheels is made of softer material than the other, the softer cog should be put in the wheel having the greatest number of teeth. The manner in which this has been carried out is shown in the accompanying engravings, Figs. 1 and 2, which illustrate the new intermediate gear as a whole, and as taken apart to show its construction.

As will be seen, the gear is made up of three separate parts: The blank or hub which is keyed fast to the axle; the removable rim which holds the cogs, and which is bolted to the hub; and lastly the wooden teeth, which are inserted in the rim. At first thought it may seem that the wooden teeth would hardly stand the strain and wear and

FIG. 1.—INTERMEDIATE GEAR AND PINION.

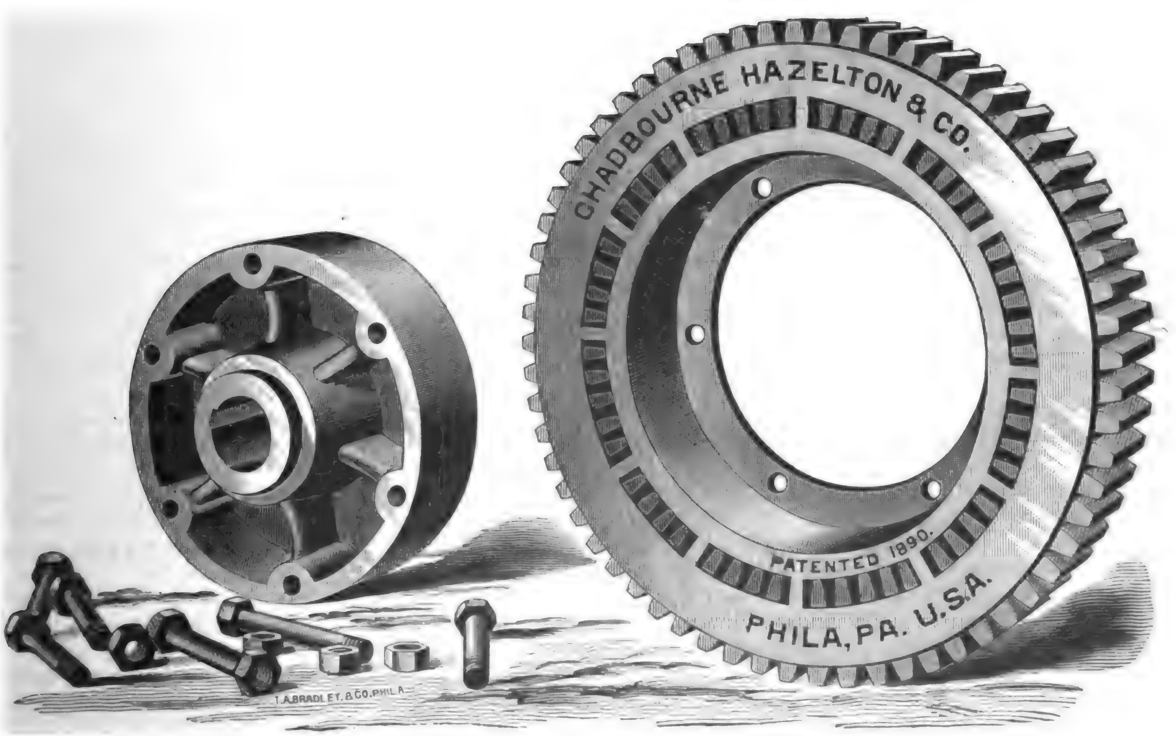


FIG. 2.—INTERMEDIATE GEAR, SHOWING RIM REMOVED.

tear which is brought upon them in street car service, but in New England, where the largest mills are driven by turbine wheels, and where thousands of horse power are used in a single mill, this entire power is transmitted through bevel gearing, the larger gear always having wooden cogs, for the reason that nothing else has yet been found that would stand the work. These cogs last several years, and then are renewed at a slight expense, being simply driven in the iron frame of the wheel, and they have the advantage of being elastic and noiseless.

The teeth which are used in these gear are of selected wood, and are driven in with white lead, and wedged at the base in the usual way; they are then put into the gear cutter and cut in the ordinary manner. The rim is made of a specially fine grade of cast iron and slips over the blank, being held in place by six bolts. Between the rim and the hub is laid a sheet of oil paper, which prevents any corrosion, and also stops any vibration or "bell tone" from the gear.

The blank is keyed firmly to the intermediate shaft and need never be removed. After the wooden teeth have become entirely worn out, all that is necessary is to remove the six bolts and slide off the rim; an extra rim with the teeth in it can then be put on, the entire change not occupying over ten or fifteen minutes. Any ordinary carpenter or wheelwright can then re-cog the old rim and cut the teeth in a half day's time, so that the expense of replacing the cogs is merely nominal.

The armature pinion is made of forged steel with the teeth case hardened after being cut.

The split gear intended for the axle is shown in Fig. 3. In order to avoid breakage and noise the same construction is employed as in the intermediate gear. The split gear is composed of two parts, the blank or hub which is split and put on to the axle, and the rim which is also split and put on so as to break joints with the hub.

These gears have been adopted on the electric railways at Atlantic City, Wilmington, Richmond, and a number of other places, where they have given excellent satisfaction.

THE DEVELOPMENT OF THE PHONOGRAPH.

BY T. C. MARTIN.

THE writer has had in his hands during the past week a volume of unusual interest and importance. It is the report by Edison phonograph of the meeting of the Association of Phonograph Companies held in Chicago last May. The convention lasted two days. In place of the stenographer, with his paraphernalia of note books and pencils, appeared the little machine that so many people are still apt to regard as a toy; and all that was said was indelibly written with the tongue. The proceedings of one day were "taken down" by the graphophone, and of the other day by the phonograph. The record made by the phonograph on May 29 comprises 40,000 words upon 61 cylinders. It has now been transcribed by typewriter, and the first copy, handsomely bound, has been sent to Mr. Thos. A. Edison for the library of his laboratory at Llewellyn Park.

The method of reporting or recording is simple. Two machines stand side by side at the place usually occupied by the stenographer. The speakers address the meeting from any point they choose, or if, like Henry Clay or Henry Ward Beecher, they walk about while they declaim, no objection is offered. As they speak, the reporter, seated at machine No. 1, repeats every word softly yet distinctly, prefacing each speech by the name of the man who makes it. The cylinder being rated to carry 1,000 words, it becomes necessary when that limit is approached to quit machine No. 1 and to begin work on machine No. 2. This is done very easily. By the time No. 2 cylinder is charged with words, No. 1 is ready once more, and again a change of position is made. The results are eminently satisfactory. The slight movement is attended by no fatigue or inconvenience, and it is not at all difficult, even with a fast talker, to carry over and continue the record. A little knack and study soon enables one to chase close upon the heels of the orator, and even to anticipate the conclusion of many of his sentences. Any good stenographer is familiar with that part of reporting work, and naturally such a man is quicker at it than one whose mind is not so trained, to become expert in the new art. One great point that presents itself to notice is that the record is ready for immediate transcription. Very often no one can read the stenographer's lines and curves but himself, and sometimes the best stenographer is baffled by notes only a few hours cold. But there is no difficulty here. Of course, as in ordinary stenographic work, the reporting staff can work in relays, and one machine take up the thread of discourse where the other drops it.

Such a performance as this to which the bulky volume of 40,000 typewritten words bears evidence is not to be gainsaid. It has to be dealt with on its merits, and all the harsh criticism in the world can but leave the fact as much a fact as ever. Since the phonograph has attained this degree of practical perfection and usefulness, it becomes more than ever an object of importance in the eyes of electricians and electrical engineers.

At the present time there are in the neighborhood of 8000 phonographs and Tainter graphophones in use in this country, the phonograph largely preponderating, it is said. Both instruments are made, rented and operated under the controlling patents owned by the North American Phonograph Company, which, with a capital of $6,600,000, has its headquarters in New York city. This company has as licensees throughout the country the following sub-companies, very much as the telephone companies are the representatives of the parent company in Boston :—

The Michigan Phonograph Company; the New England Phonograph Company; the Wisconsin Phonograph Company; the Kansas Phonograph Company; the Western Pennsylvania Phonograph Company; the Pacific Phonograph Company; the Ohio Phonograph Company; the Columbia Phonograph Company; the Florida Phonograph Company; the New York Phonograph Company; the Nebraska Phonograph Company; the Texas Phonograph Company; the Missouri Phonograph Company; the Minnesota Phonograph Company; the New Jersey Phonograph Company; the Iowa Phonograph Company; the Spokane Phonograph Company; the West Coast Phonograph Company; the Alabama Phonograph Company; the Colorado and Utah Phonograph Company; the South Dakota Phonograph Company; the Montana Phonograph Company; the Georgia Phonograph Company; the Kentucky Phonograph Company; the Eastern Pennsylvania Phonograph Company; the Tennessee Phonograph Company; the Wyoming Phonograph Company; the Central Nebraska Phonograph Company; the Old Dominion Phonograph Company; the Chicago Central Phonograph Company; the State Phonograph Company of Illinois. The names of these corporations fairly mark out their territory. The Kansas Company operates also in New Mexico; the Columbia (D. C.) Company in the States of Maryland and Delaware; the Missouri Company in Arkansas and the Indian Territory; the Old Dominion Company in Virginia, North Carolina and South Carolina. These 31 companies, many of which are of recent formation, represent a capital that probably approximates $20,000,000. All of them are at work, and not a few are experiencing a very rapid growth of business.

It would, in fact, be rather difficult to determine the bounds of phonographic development, so varied and numerous are the avenues of employment that open up to it. Verbatim reporting is one of these, and but small. The machine is finding its way with quiet swiftness into all manner of business offices. One firm in Chicago uses 8; another house in Richmond is not satisfied with less than 16.

A large number are rendering excellent service in editorial and publishing offices. The Electrical Engineer has two, and will soon have more. Out in Milwaukee, two printing offices have made a specialty of setting up from phonographs, the compositors dispensing with time-honored "takes" of copy. Cleaner proofs are the result. Under such a régime Horace Greeleys cease to be a terror to the inoffensive "comp." A large number of lawyers, patent solicitors, stenographers, clergymen, authors, actors, musicians, linguists and other professional men are using the machines. An interesting and novel feature is the use of the machine for obtaining daily reports from foremen in large factories. Such men can generally talk vigorously and well, but a pen they shun and abhor. It has been discovered, however, that they will "pour out heart affluence in discursive talk" upon a waxen cylinder in a most admirable and effective manner; and this new method of factory reports is naturally coming into vogue with gratification to all parties concerned. Out of the whole 8,000 machines, it is estimated that 75 per cent. are in business service. New York has already 600 machines running.

The motive power to run the machines is a subject that is still actively discussed. This question can hardly be settled yet. The phonograph is driven by the ingenious little motor invented by Mr. Edison for the purpose; but that motor is energized in various ways. Sometimes the current is derived from an Edison-Lalande battery, one great advantage of which is its constancy. Sometimes the current is taken, through a resistance, from the incandescent lighting circuits. There is a very general preference for storage batteries, and nearly all the makes have been tried. With the graphophone have been coupled Lugo and other motors; and the small size Perret has been found very successful. In view of the fact that the 8,000 machines bid fair to become 800,000 in the next ten years, it will be seen that this question of motor and current for them is not one of the least interesting now before the electrical community. The customer of the sub-company pays $40 for his machine per year, or the small sum of 75 cents per week. The supplies are extras, of course, and there is a vast field for work and ingenuity in many of their details. By and by it may become a general practice for the companies to furnish the supplies to their patrons on a certain "flat rate" annual basis.

Amusement phonographs are still new, for, although countless exhibitions have been given, we have but barely entered on the nickel-in-the-slot period, when music and oratory, song and speech will be on tap. Nickel-in-the-slot phonographs have proved immensely popular whereever introduced, and there is not the slightest reason to believe that the favor they are in will be simply a short-lived craze. Every week brings forth its new singer, its new song, its new march or air; and the public has an ear that likes to be tickled. The phonograph as a Joe Miller jest book, telling the latest as well as the oldest good story, is an amusing companion. Incised with a yarn and a laugh from Eli Perkins, it is in more senses than one a "howling success."

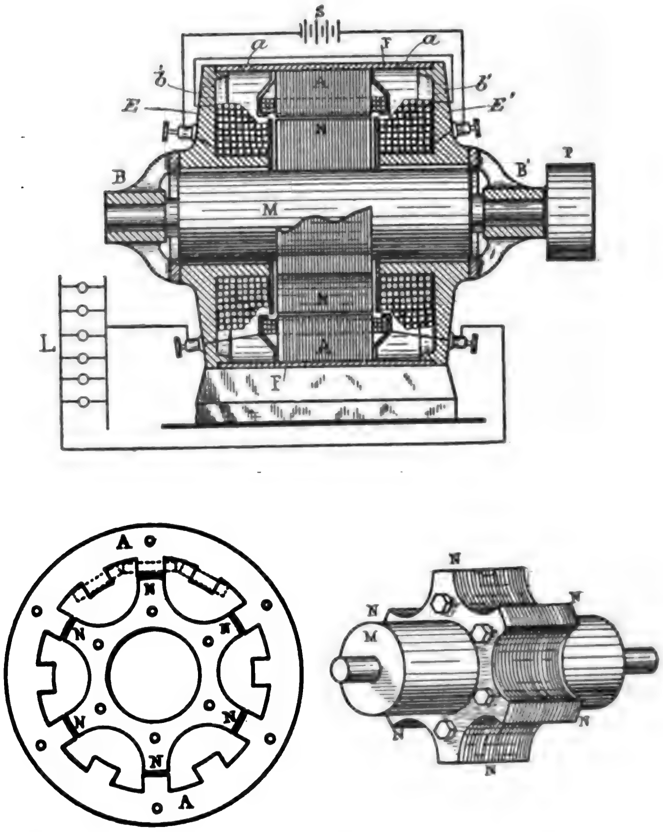
The past week, which has seen the issuance of this phonographic report has by strange coincidence seen, also, the issuance of an order from Washington for the treatment of phonograms as other ordinary mail matter. This is a step forward, and will lead to other improvements and developments, especially, it may be assumed, in the standardizing and unifying of apparatus, so that the same machine and the same record cylinder serve the same purpose everywhere.

The Elgin, Ill., Electric Railway, which has recently been equipped with the Sprague system and was started up on the 4th of July, ran from the start without the slightest hitch, although no previous tests had been made of any of the power or electrical plant. The road was started with 2 cars, which they have already increased, and added another 50,000 watt generator. The cars were run free at the start till 12 o'clock, after which till 10 p. m. 4667 nickels were taken in fares.

PROF. THOMSON'S NEW ALTERNATING MACHINE.

With the high speeds now generally employed in alternating current machines the moving coils are more or less liable to derangement, so that they are subject to both mechanical as well as electrical strain. In order to overcome this difficulty and to obtain a compact as well as efficient machine, Prof. Elihu Thomson has recently constructed an alternator in which all the coils are stationary, and so that no moving contacts whatever are necessary to conduct the current from machine to line. The machine is shown in section in the accompanying illustration, Fig. 1, and consists of a stationary armature A, Fig. 2, within which revolves the field magnet, shown in Fig. 3.

The armature A is built up of a number of ring-shaped plates or sections of rings bolted together to form practically a compound laminated ring. It corresponds in a



Figs. 1, 2 and 3.—Thomson's New Alternating Machine.

measure to a fixed laminated armature, and is supported in the interior of the outside casing.

The end plates E E' are joined at their outer portions by the iron frame-work or casing F, consisting of a cylinder surrounding the machine. It is designed to connect the outer edges of the end plates E E' magnetically with the stationary laminated ring A, surrounding the core M so as to embrace the centrally projecting portions of the core M. To the inner side of the structure A, and upon projections extending radially inward, are applied the coils, the ring and coils thus resembling a multipolar ring or cylindrical-shaped magnet whose poles are on the inside.

The field magnet coils are supported fixedly in the casing and energize the multipolar field magnet M, all the poles of which are of like name, as shown at N, N, etc. The core M is fixed to the shaft of the machine and has the laminated pole pieces keyed to it.

The ring structure A A has interior projections of double the number of the projecting poles N N N, carried by the ring core-piece. On these projections are firmly secured the coils in which currents are to be induced, and which are connected to the line wires. The field magnets, of

course, require to be energized by a continuous current which can be furnished by a separate exciting machine.

The action of the machine is as follows: The moving field-poles N N N, etc., carried around on the revolution of the core-piece M, pass in front of the coils in which the currents are to be induced. The lines of magnetic force projecting from these pole-pieces cut across the wire on the coils transversely. The direction of the winding and the connection is such as to make the effects cumulative in the coils—that is, so that if a polar projection N passes, as in Fig. 2, over the centre of one coil to that of the next its lines are caused to cut the wire lying between those centres, half of which would belong to that coil, the centre of which is being left by the traveling pole, and half to the coil toward the centre of which the traveling pole is moving.

These actions of induction repeatedly following one another will be accomplished without a reversal of magnetism in the core-piece or even in the laminated ring structure supporting the coils in which the currents are induced; but, on the contrary, the lines of force will simply be carried rapidly past wire whose virtual direction of winding is opposite alternately, and this will generate impulses without the necessity of magnetic changes of polarity taking place in any of the core-pieces. Prof. Thomson is thus enabled to save a large portion of the loss due to magnetic changes or "hysteresis," in the iron of the machine, while still utilizing the iron to the best advantage in the construction of the magnetic masses subject to the magnetizing actions of the field-energizing coils. There is also secured a strong magnetic field by the expenditure of a minimum of energy in sustaining the same, besides which none of the wire of the machine need revolve, thus dispensing with rubbing-surfaces or sliding contacts when the machine is used for the generation of alternating currents.

ELECTRIC POWER AT GLOVERSVILLE, N. Y.

THE work now being done by electric motors at Gloversville, N. Y., the largest glove manufacturing town in the United States, is of more than ordinary interest, and presents one or two novel features. The Gloversville Electric Company started their plant on December 1, 1889, and began to supply electric power just a month later. They are now operating 26 motors ranging from ½ to 2 h. p., and these 26 machines represent so many different glove factories. The ½ h. p. motors run eight sewing machines each; the 1 h. p. from 12 to 14 machines; and the 2 h. p. from 18 to 22 machines. The prices for current are $90 per year for 1 h. p. and $35 for the use of the motor; $50 for ½ h. p., and $25 for use of motor; $175 for 2 h. p. and $50 for use of motor. The motors are owned and supplied by the company. The users have become familiar with their care, and they give very little trouble to the company in the care of them; but they are of course kept under surveillance and a weekly inspection.

The service is furnished from 7 A. M. to 6 P. M, each day, with an intermission at noon, and proves very satisfactory to its patrons. The power is supplied by Thomson-Houston arc machines generating a current of 6.8 amperes. These machines are used at the end of the day for lighting the town with arc lamps. The motors used are the constant current made by the Excelsior Electric Co., of this city, and have been found eminently suitable for their work. The Gloversville company now have applications for power as high as 40 h. p., and they are considering the advisability of putting in large generators to deliver a 500 volt current to furnish power for that special work. The company are obtaining their prime power from compound condensing engines, that answer admirably and are preferred to the ordinary non-condensing high speed type.

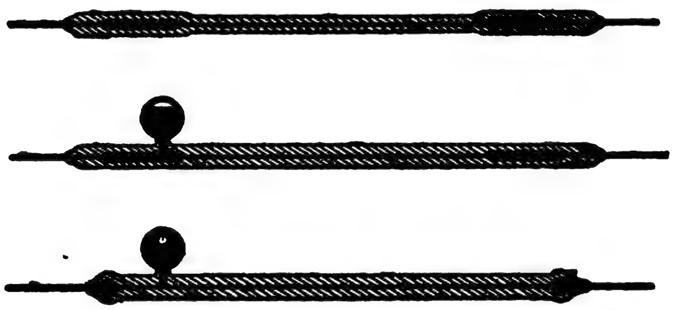
The company have begun to furnish motors as small as ⅛ h. p., running the service right into the houses of the operators, so that as the work is paid for by the piece, they can take it home and do it outside the factories. This is a little point, but it has its significance.

The factories really make money by the motors they put in, as they charge the "help" that use the machines 50 cents per week for the use of the motor, the work being done by the piece, as stated above. At first no little objection was made to this, but now the operators are glad to pay the charge, for the reason that they are enabled to do very much more work with the machine run by the motor than in the old way. There is thus a saving and a higher profit in the work for everybody concerned.

FIELD'S MERCURY THERMAL CUT-OUT.

The protection of telegraph and telephone apparatus from abnormal currents has led to the construction of a large number of cut-outs, both electro-magnet and thermal in their nature. In order to avoid the introduction of an electro-magnetic device which might introduce retardation, and on the other hand to overcome the objection to lack of uniformity and fragility in fine fuse wires, Mr. Stephen D. Field has recently invented an ingenious cut-out in which mercury is employed as the fusible, or rather volatile, material. Another object aimed at is to obtain such a construction that upon the cessation of the abnormal current the circuit to the instrument is automatically restored without the replacement of any material in the cut-out.

The simplest form of Mr. Field's cut-out is illustrated in the accompanying engraving, Fig. 1. It consists merely



FIGS. 1, 2 AND 3.—FIELD'S MERCURY CUT-OUT.

of a glass tube with a fine bore which is filled with mercury and has two conducting wires sealed in at the ends. The passage of an abnormal current heats the mercury, vaporizes it and the pressure generated bursts the tube, thus rupturing the circuit.

In order to provide for the automatic closing of the circuit above referred to, the construction shown in Fig. 2 is employed. Here a chamber is placed at one end of the tube, which is part filled with the mercury. The air, which occupies a portion of the chamber, being an elastic medium, allows the expansion due to the vaporization of the mercury in the capillary portion to take place without rupturing the structure, as the air becomes compressed and the separation of the column of mercury in the capillarly tube can take place, thus opening the circuit in a reliable manner without destroying the apparatus,

Another form of cut-out, shown in Fig. 3, is similar to that shown in Fig. 2, except that instead of leaving a open air-space in the chamber, a rubber ball filled with air is placed in it and the chamber completely filled with mercury This prevents the escape of the air from the chamber into the capillary tube in transporting or handling the appaatus, while affording a sufficiently elastic medium to preserve the apparatus from destruction by the vapor-pressure gnerated in its operation.

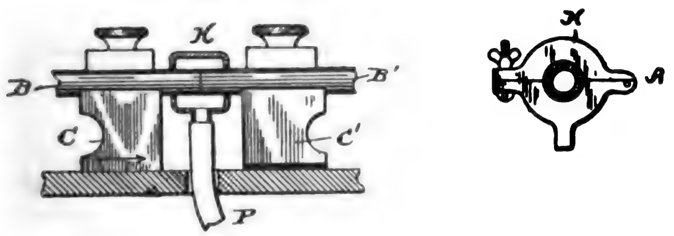
Among the practical advantages claimed by Mr. Field for this form of cut-out, are first, that, if using only pure distilled mercury, it is possible to have absolute uniformity in the conductivity of a given size of cut-out. Again, the

construction of capillary tubes of glass has reached such a stage of perfection that it is entirely practicable to have a given diameter uniformly reproduced, and, furthermore, the diameter may be very much smaller than it is possible to draw any of the known fusible wire metals or alloys. Again, mercury has a very high coefficient of resistance. It therefore becomes possible and entirely practicable to construct thermal cut-outs of this character so as to permit an exceedingly small fraction of an ampere to volatilize the mercury at the point of least diameter, and the action will take place invariably at the same critical temperature. We have seen the cut-out in operation and it seems to fulfill all the claims made for it by Mr. Field.

THOMSON'S METHOD OF ELECTRIC CASE-HARDENING.

Prof. Elihu Thomson has already devised a variety of ways of working metals by means of the heat generated in them by the passage of the electric current, and has recently added to these another interesting method de signed to case-harden the metals, such as iron or steel. The process consists essentially in heating the object electrically, and then applying to the metal so heated a surrounding envelope (either gaseous, fluid or solid), for the purpose of changing or preventing change in the quality of the material, according to the special end to be attained.

The method is applicable not only to those cases where it is desirable to prevent oxidation or change of character



Figs. 1 and 2.—Thomson's Electric Case-Hardening Process.

in the surface of the metal object which is heated in the welding, forging, or shaping operation, but is also applicable to producing an addition to, or modification in, the character of the surfaces of the metal object, either independently of, or simultaneously with, the forging, shaping, or other working operation performed upon the metal. Thus, for instance, it can be applied to the local hardening of parts of steel bars and the local case-hardening of iron or mild steel bars when heated by the passage of the current for the purpose of welding, forging, shaping, etc.

To prevent oxidation Prof. Thomson surrounds the iron and steel bars with a hydrocarbon gas or other gas containing no oxygen, such as hydrogen or nitrogen. To chill and harden steel the heated bars are suddenly surrounded with cooling-fluid, such as water or oil. To case-harden the bar it is surrounded with a layer of case-hardening flux—such as cyanide of potassium, yellow prussiate of potash, shavings of horn, animal charcoal, leather cuttings, and carbonate of potash, or the like—and the pieces kept hot by the current until the required case-hardening is effected as a result of the addition of carbon to the surface layer of the material.

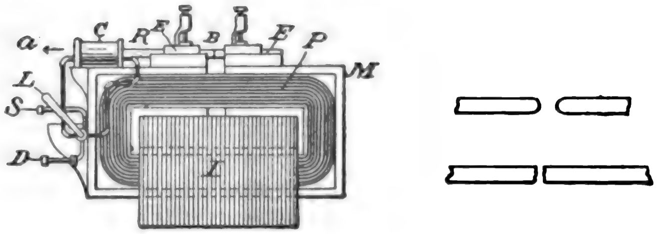
The accompanying illustration, Fig. 1, shows the apparatus designed to accomplish this. As shown, the bar to be treated is surrounded by a casing, K. This casing is supplied, through a pipe, P, with ordinary coal-gas or gasoline-vapor during the heating of the metal, so as to preserve the same from oxidation during the welding or like operation performed upon the object heated.

The casing is constructed of sheet-iron, and made in two parts, hinged at A, as shown in Fig. 2. Evidently it must not make electrical contact with the object treated, but must be guarded therefrom by mica, asbestos, or other insulating and refractory material applied at the points where the object enters the casing.

Oxidizable metals are by this means thoroughly protected at their surface, and, in fact, with gases rich in carbon, will receive when highly heated a veritable protective layer of deposited carbon, which gradually carbonizes the surface of an iron bar while heated and steelifies or case-hardens it.

LEMP'S METHOD OF ELECTRIC SWAGING.

Among the recent developments of the electric welding process of Prof. Elihu Thomson, is a method of swaging metals devised by Mr. Hermann Lemp, of the Thomson Electric Welding Co. The apparatus employed for this purpose is shown in the accompanying engraving, Fig. 1,

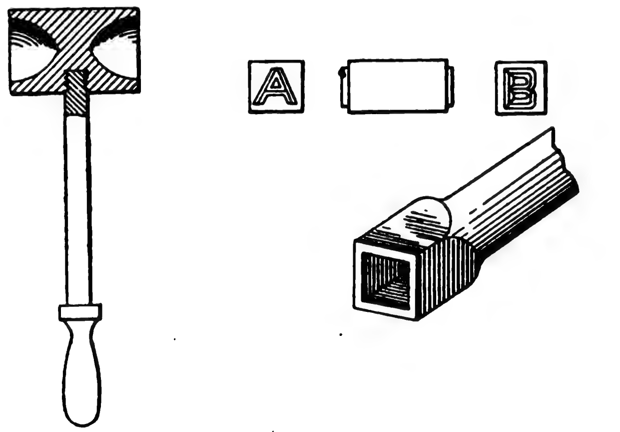


Figs. 1 and 2.—Lemp's Method of Electric Swaging.

and will be seen to consist of a welding transformer, one clamp of which is made movable.

The latter clamp is actuated by means of a piston-rod, B, secured to a piston working in a cylinder, C. Steam or air pressure is applied at opposite ends of the cylinder through pipes controlled by a four-way valve, the handle of which is indicated at L. In one position of the handle communication is opened between the inlet, S, and one end of the cylinder and between the outlet, D, and the opposite end, so as to move the clamp toward the opposite one. In the reverse position of the handle the condition is reversed, the inlet, S, being connected with the proper end of the cylinder to produce a reverse movement and the outlet, D, with the opposite end.

The operation of the apparatus is as follows, B being the bar or piece of metal which is to be manipulated. After



Figs. 3, 4, 5 and 6.—Lemp's Method of Electric Swaging.

clamping, the current is turned on until the portion of the metal between the clamps is heated and softened, when, through the application of pressure the cylinder bar is divided into two pieces. It is advisable to stop the current just before the separation, thus leaving two pieces such as shown in Fig. 2. By separating the bar quickly the ends will be left as in Fig. 3. The two pieces with their ends in plastic condition having been thus formed, the double forming device or holder—such as shown in Fig. 4—is placed between the ends of the heated bars, and the lever, L, is turned into position so as to cause the

clamps to approach one another, thus pressing each hot end and the die or former together, so that the metal will assume the shape of the forming or swaging device. In this instance a conoidal form is given to the end of the bar. The shaping device interposed between the two ends of the heated metal might be a die, as shown in Fig. 5, in which case each hot-metal piece would be made into a stamp.

The production of a tool such as indicated in Fig. 6 by the process described is obvious, it only being necessary in such case to use a die or former which shall shape the metal into the form indicated after the heating of the blank in the clamps or holders, as before described.

It is obvious that by this method of procedure metal may be shaped with great expedition, as no time is lost in the removal of the metal from the clamps or holders of the electric-heating apparatus.

AN ELECTRICAL EFFECT[1].

It may be of value to remind teachers of an effect not generally known, which is produced by varying the ordinary mode of performing the experiment of putting pieces of zinc and silver in the mouth and touching them, to obtain the acid taste which accompanies the completion of the electric circuit.

If the piece of zinc be placed under the tongue, and a florin vertically between the upper lip and the top row of teeth, and the two metals be brought in contact, a faint flash is seen in both eyes when the eyes are open.

If the eyes are shut the sensation of light is not felt, so that the effect is probably due to a muscular twitching.

It is necessary to use a large silver coin, and not a shilling, and to push it well home behind the upper lip.

The experiment so made seems to be a handy and simple illustration of the meaning of subjective phenomena.

A NOVEL ELECTRIC RAILWAY POLE-TOP.

A glance at the electric railways in this country will show a number of poles of different designs now in use. How serviceable the different forms are will depend on the rigidity of the pole and partly on the design of the pole-top. That the pole should stand a great side-pull without

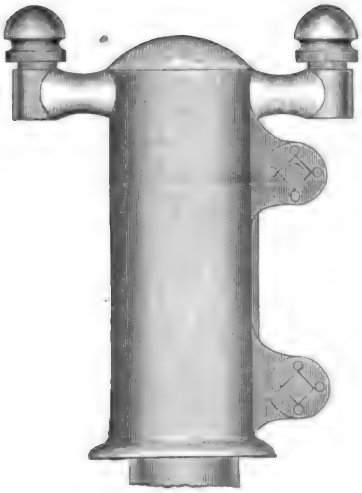


Fig. 1.—The Verstraete Pole Top.

much bending was early seen, but only lately has due attention been given to the features needed in pole-tops. These should be strongly made, so shaped as to shed the water, and should insulate both trolley and guard wires from each other and from the pole. Then there should be ready means of taking up the slack in both of the suspension wires, and two insulators for carrying the feeders. These features seem to be embodied in the new pole-top designed by Mr. Edmund Verstraete, the electrician in charge of the construction of the Union Depot Railway Company's plant in St. Louis.

As shown in the accompanying engravings, it is an iron cap which may be used with either iron or wooden poles. The wooden poles do not need to fit it tightly, as the pull of the guy-wires will keep it pressed against one side of the pole. The pole-top is merely slipped over the end of the wood poles, the top adjusting itself. With iron poles a wooden plug and a wood bushing is used, as shown in the section Fig. 2. These bushings are thoroughly soaked with Simplex paint; and as the iron flange keeps the adjacent

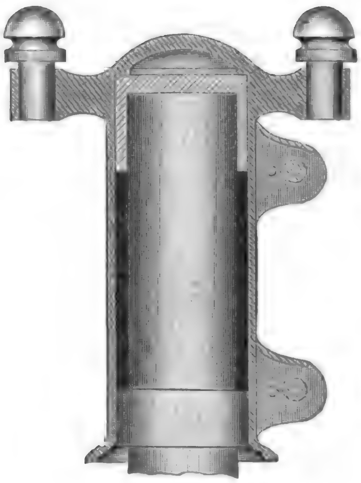


Fig. 2.—The Verstraete Pole Top.

part of the pole dry, the top is always insulated from it. The lower end of the pole-top is flared out so as to shed the water, and keep the upper part of the pole dry; this insures the insulation of the trolley wire from the ground.

The suspension wires are wound on a drum, whose enlarged ends have six holes; a pin through one of these holes keeps the drum from unwinding. These pins cannot drop out, yet allow the slack of the wires to be readily taken up. The drums for the guard wires is 9 inches above that for the trolley wire, and is made of insulating material. The insulators for carrying the mains or feeders are above the guard wire; hence if both the trolley and the guard lines are put up before the mains are, the latter need not be slipped through between the suspension wires, but are readily thrown over the top and fastened to the insulators. The pole-top is well built, simple and inexpensive, and seems to be eminently practical. It is made by the Great Western Electric Supply Co., Chicago.

A SERIES STORAGE BATTERY.

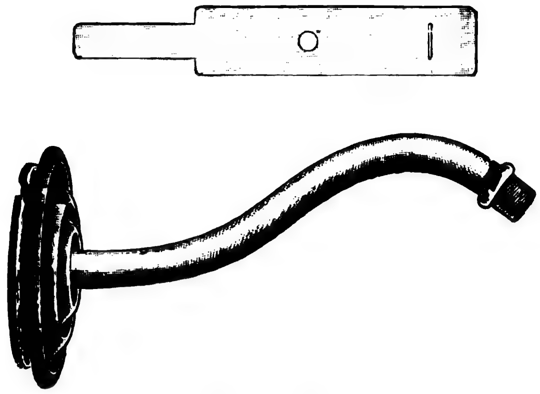
There has recently been brought out in London a storage battery designed especially for lighting on a small scale, such as carriage lighting, which embodies some novel features. The battery consists of a wooden cell, divided into separate partitions by the battery plates. The opposite sides of a plate are therefore of an opposite character; one side being, as it were, positive, and the other negative. The plates in a cell are therefore in series, and no electrical connections whatever are required, except at the two end plates. A wooden frame between the plates prevents buckling. A box 14 in. long, 4¼ in. wide, and 6 in. deep, will contain a battery of 24 plates, that is, 24 cells; and this, we are informed, will yield 18 amperes at 48 volts. The plates are cast with square recesses, for holding the peroxide, and probably would discharge at a rate comparing fairly with other accumulators.

The Sprague Electric Railway and Motor Company, through their Chicago office, have just closed a contract at Fort Scott, Kan., to build five miles of road, to be equipped with six cars and one 110 horse-power generator.

1. Edward B. Cook, in *Nature*.

DETAILS OF THE INTERIOR CONDUIT SYSTEM.

Last week we were enabled to show diagrams illustrative of the manner in which, by resorting to the "crib" system, the Interior Conduit and Insulation Co. introduced their tubes into and throughout buildings. No reference was made, however, to the details of construction, which are equally worthy of note. As the tube comes in sections, it is obviously necessary to bring sections together in order to afford the continuous channel for the wire. In Fig. 1 is



Figs. 5 and 6.

shown the threading tool with which is furnished a complete set of dies for all sizes of the tube; Fig. 2 is a section of conduit showing threaded end as used with screw coupling, and Fig. 3 is a sectional view of the screw joint with the coupling in position. The couplings are sometimes of metal. When the lengths have been coupled together, and the run is complete, powdered soapstone is blown through the tube to smooth the way for the wire, which is then fished through very easily with the help of a

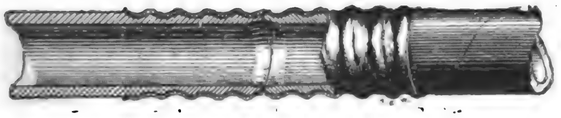


Fig. 3.

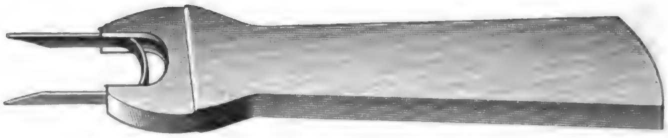


Fig. 4.

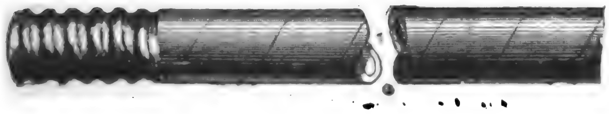


Fig. 2.

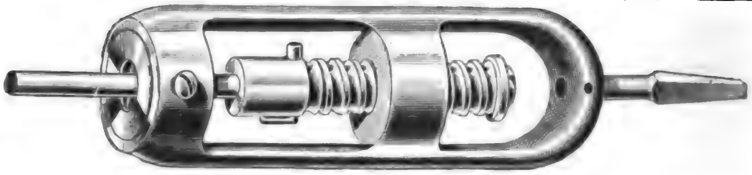


Fig. 1.

Details of the Interior Conduit System.

crinoline steel fishing wire, at the front end of which is a little ball or leader on a universal joint, giving it free play to turn in any direction. As many as four elbows can be gone around with a flexible wire in this way. At the junction and intersection boxes the tube is carried in fully.

In fastening the tube to walls or beams either staples or brass clips are used, the latter being preferable, and in some places made compulsory by the Fire Underwriters. Where staples are employed they are driven by the staple driver, Fig. 4, provided for the purpose, thereby avoiding any chance of injury to the tube. The clip, Fig. 5, is recommended, as it is more easily used, and can be employed where difficulties are met with in fire proof buildings in driving home both legs of the staple. Its position may be easily lined out. A French nail is used to attach the clip to wall or beam, and after the tube is in position the tongue of the clip is pushed through the slot, provided for same, and drawn tightly by means of pliers. If desired, the ends of the clip may be cut off.

As a general rule, only six or eight lights are distributed from one tap, and the company prefer to use their flexible "twin conductor" for the branches with the two conductors in the one tube. Many details of feeder terminals, main and branch junction boxes have been worked out. In

Fig. 7.

Fig. 6 is a one-light bracket with locking canopy to fit a junction box, and Fig. 7 shows another variety of attachment in an ingenious spring ceiling pendant.

ELMORE'S COPPER DEPOSITING PROCESS.

Our readers will remember that about two years ago the Elmore process of copper deposition was brought out, which consists in depositing the metal upon rollers over which travel agate burnishers so that the copper as deposited is smoothed down and compressed.

The company formed to work these patents has made considerable progress since that time. Works of some magnitude have been acquired near Leeds, which leave room for extension. At present the plant laid down is capable of turning out five tons per week, and this is being increased at the moment to a fifteen tons capacity. Several samples of work that have been executed by the company, have recently been exhibited. These embrace specimens ranging from threads which have been passed cold through dies of $\frac{1}{1000}$ inches diameter drawn down from spirally cut sections to this dimension, up to pipes 18 inches in diameter and 14ft. long. Of the thread 40 miles in length go to the pound, and it looks like a bunch of hair, while the pipes shown are ¼in. thick, though the thickness may be increased to any desired extent. When it is understood that these results are achieved direct from Chili bars without any annealing whatever, and therefore without any detriment accruing from this operation, some idea will be formed of the purity. Specimens were exhibited that had been treated very severely, yet no harm had been done to the metal. It was as homogeneous as before it was touched. The invention accomplishes all this by eliminating the foreign matter always found with copper in its usual form. Up till now the company has confined its work to straight tubes of an even thickness, but the system admits of extra metal being deposited where required. If, therefore, a bend is necessary, it is proposed to take advantage of the irregularity allowed by this process to make the necessary shape.

CONTRIBUTIONS TO THE MOLECULAR THEORY OF INDUCED MAGNETISM.[1]

BY PROF. J. A. EWING, F.R.S.

AFTER referring to Maxwell's discussion of Weber's theory, which ascribes magnetisation in iron and other magnetic metals to the turning of molecules which are already permanent magnets, and to suggestions made by Profs. Wiedemann and Hughes, and lately by Mr. A. E. Kennelly,[2] the writer describes experiments which he has made directly bearing upon the molecular theory. The experiments were made by grouping near to one another a large number of small permanent magnets, each pivoted on a fixed centre, and by studying the manner in which the configuration of the group changed when external magnetic force was imposed. The results do not support the notion that the molecular magnets form closed chains in unmagnetised iron. They lead, however, to the important conclusion that no arbitrary conditions of directional constraint need be postulated to make the manner in which the molecular magnets turn agree with the chief features of magnetic quality. In the writer's view the molecular magnets are perfectly free to turn in response to external magnetic force, except in so far as they are constrained by the magnetic forces which they exert upon one another. He discusses this theory in a preliminary manner with regard to the form of the magnetisation curve, the character of cyclic processes, the effects of temperature, of vibration, of stress, and so forth, and shows that it is in general agreement with the known facts. The summary of conclusions is as follows :—

I. That in considering the magnetisation of iron and other magnetic metals to be caused by the turning of permanent molecular magnets, we may look simply to the magnetic forces which the molecular magnets exert upon one another as the cause of their directional stability. There is no need to suppose the existence of any quasi-elastic directing force, or of any quasi-frictional resistance to rotation.

II. That the intermolecular magnetic forces are sufficient to account for all the general characteristics of the process of magnetisation, including the variations of susceptibility which occur as the magnetising force is increased.

III. That the intermolecular magnetic forces are equally competent to account for the known facts of retentiveness and coercive force, and the characteristics of cyclic magnetic processes.

IV. The magnetic hysteresis and the dissipation of energy which hysteresis involves are due to molecular instability, resulting from intermolecular magnetic actions, and are not due to anything in the nature of frictional resistance to the rotation of the molecular magnets.

V. That this theory is wide enough to admit explanation of the differences in magnetic quality which are shown by different substances, or by the same substance in different states.

VI. That it accounts in a general way for the known effects of vibration, of temperature, and of stress, upon magnetic quality.

VII. That, in particular, it accounts for the known fact that there is hysteresis in the relation of magnetism to stress.

VIII. That it further explains why there is in magnetic metals hysteresis in physical quality generally with respect to stress.

IX. That, in consequence, any (not very small) cycle of stress occurring in a magnetic metal involves dissipation of energy.

THE NEW WESTERN UNION BUILDING.

The directors of the Western Union Telegraph Company held a special meeting on July 22, and were in session for an hour and a half. A long discussion of the fire and the means necessary to overcome its effects resulted in a decision to rebuild all above the fifth story. It was finally unanimously determined to construct four floors above the fifth, making the structure a nine-story building. In order to get still more room, the directors decided to build on the top of the building at No. 8 Dey street, which is owned by the company, and by means of the low roof of which the imprisoned employees were rescued during the fire. The reconstructed Western Union building will be plain and square, the present tower and ornamental top being dispensed with. As the Dey street building is twenty-seven feet wide and as deep as the present central building is wide, all the additional room that the company has been in need of for some time will be secured. The sixth floor will be used wholly for offices, in addition to the third floor, where the present offices are located. The seventh and eighth floors will furnish two operating rooms about 75 by 23 feet each. The Associated Press will have quarters on the seventh floor, in the new part of the building. The elevator in the Dey street building will run up to the ninth floor. The entrance to the Associated Press rooms will be on Dey street, as well as through the present building. The ninth floor will be occupied by a kitchen and restaurant for the employees. All the batteries and dynamos are to be located in the cellars of the building. The dynamos have been there for some time, although at one time they were operated up on the battery floor. The material of the new part of the building will be brick and iron, very much like that of the old portion. The time ball will be worked on top of the square roof, perhaps on a flag staff.

The directors gave General Manager Eckert full power to carry out their plans. J. B. Smith, builder of the present structure, will be engaged to do the work.

The work of tearing down the three upper stories will be begun immediately. The cost of remodeling and enlargement will be great, but no estimates have yet been made.

The relation of the New York business to that of the country, and the fact that the bulk of the Western Union's revenue comes from handling local messages, is shown by the reports from the test offices. It is the company's practice to receive reports each week from its central offices in all the larger cities of the United States. The business transacted by these offices amounts to more than half of the total business of the company, and their reports, therefore, afford an immediate and reasonably accurate index of the condition of the company's affairs. The reports for the week of the fire from the test offices, which are not directly dependent on New York for the bulk of their business, show almost the regular increase over the corresponding week of last year. In every city which is a business centre, with outlying towns dependent upon it, the bulk of the business is local. In the Mississippi Valley the company's business centres more largely at Chicago than in New York. For these reasons the returns from almost every test office west of the Alleghanies and south of the Potomac show a steady growth for the week ending last Saturday as compared with the same week in July, 1889. Of course, in the Eastern and Central States, where all except purely local business is more or less dependent upon New York, the company's work has been very greatly crippled. At the same time, the resulting loss is less than might have been expected. The company's entire business for the week was $10,000 ahead of last year. As the regular weekly increase is about $25,000, the effects of the fire, as shown by a falling off of $15,000 in the total volume of the company's receipts, have been comparatively insignificant.

THE KNOWLES STORAGE BATTERY.

We have recently had occasion to examine a new storage battery, the invention of Mr. E. R. Knowles, the well-known electrical engineer, who has had a large experience in the construction and manufacture of storage batteries, and in which many of the difficulties heretofore experienced in such cells appear to have been successfully overcome.

The new battery, as made by him, is novel and durable in construction, so that it will withstand mechanical and electrical shock without being disorganized or disrupted, or lose the active material out of its plates. In fact, as the plates are constructed, it would seem impossible for the active material to get loose or come out under any kind of ill usage. All liability of the plates to curl or buckle and injurious sulphating appears to be eliminated. The plates have a large storage capacity for their weight, and their efficiency is high. The cell is quite simple in construction, embodying several new features, and the support plates are unchangeable and unoxidizable. The cost of the cell has been reduced to a minimum, almost the entire method of construction being mechanical in its character, very little hand labor being employed.

A complete battery of these cells has been in active operation daily for the past eight months, subjected to very severe tests of various kinds, and successfully sustaining them all, the battery being in as good, if not better, condition now as it was when first set up ; and it would seem that the claims made by Mr. Knowles for his battery have been fully substantiated by its performance. In addition to this, the battery is made on a principle, covered by existing patents and others which are pending, which, it is claimed, places it outside the pale of present litigation, it being neither a battery of pasted plates nor a battery in which the active material is mechanically applied to the support plate. It is also claimed not to be a secondary-storage battery but a primary-storage battery, being constructed in such a manner as to be active when first set up, and hence able to give a current of electricity at once, without being acted upon by a current from some external source, thus saving time and expense in formation. Arrangements are now being made to place this battery on the market.

IN MEMORIAM—W. H. SNELL.

We have received from England a memorial pamphlet dedicated to the memory of Mr. W. H. Snell, the brilliant young editor of the *London Electrician*, who died this year only thirty-one years of age. It has an excellent steel engraving of Mr. Snell as frontispiece, and is a compilation of various testimonials as to his worth and work. The utterances thus included are from such men as Gisbert Kapp, W. M. Mordey, A. Reckenzaun, Guy Fricker, George Forbes, Oliver J. Lodge, J. A. Fleming and F. H. Webb.

1. Abstract of Paper read before the Royal Society, June 19, 1890.
2. THE ELECTRICAL ENGINEER, June 11 and 18.

CORRESPONDENCE.

CHICAGO.

Manufacturing in Chicago—Silicating Copper—The World's Fair Electrician—A New Electrical Organization.

THE announcement made recently of the sale of the Morgan tract, in Sec. 28, Calumet, has had already a marked effect on values in the vicinity. The property was held by the estate of D. S. Morgan. It comprises 477 acres. The price is $500,000. The significance of the sale lies in the fact that the ultimate purchaser is understood to be the Westinghouse Electric Company, and that the plans of the company contemplate the erection of large shops which will employ 1,500 men. The land purchased is considerably more than will be required for manufacturing uses, and a portion of it will probably be sold in lots, so that the cost of the land actually needed will be greatly reduced if not entirely made up from the profit of such sales.

The Washburn and Moen Company will soon begin to build its barb wire works on the land recently purchased near Cummings.

Mr. E. P. Wilson, of the Evanston Electric Light Company, will remove to Cincinnati, where he has been appointed commissioner of the Cincinnati Freight Bureau.

Mr. George G. Mullins, of Los Angeles, Cal., who is at present in Chicago, at the Leland House, claims to have discovered a method for silicating copper. He says:—"Electricians have always had an obstacle to combat for want of this method, which, by its purifying qualities, greatly increases electrical conductivity. By its means an absolutely pure copper casting can be made. When there is a flaw in a copper wire great annoyance results, and when that wire is in an underground conduit the annoyance and expense are greatly increased. Many experimenters have been searching for the method but without success." The method is understood to be thoroughly covered by patents.

The Chicago *Evening Post*, of July 21st, devotes a column and a half to electric work in Chicago, and the discussion of the merits of the gentlemen proposed for the appointment of electrician-in-chief of the World's Fair. Those informally proposed are:—Professor Elisha Gray, of Highland Park; Professor W. A. Anthony, of Manchester, Conn., and Mr. John P. Barrett, city electrician of Chicago.

An ordinance granting more time to the People's Electric Light and Motive Power Company of the town of Lake, has been vetoed by the Mayor.

A meeting of about 200 men employed in the construction departments of the electric light companies held a meeting last week at 167 Washington street and formed an organization. James C. Malloy was chosen temporary chairman and C. A. Roff, of the Chicago Edison Company, and E. Z. La Plante, of the Thomson-Houston Company, as secretaries. Addresses were made by Robert Nelson, M. T. Britzins, W. C. Pomeroy, James O'Connor and James Conrad, and all present became members of the organization.

CHICAGO, July 25, 1890.

PHILADELPHIA.

The Electric Lighting Interests of Philadelphia.—The Suburban Electric Co.—A Thomson-Houston Suit.

BEFORE many months the entire built up portion of the city will be strung with wires, and the gas works will be squeezed out of business by private companies making a better and cheaper light. There are eleven electric light companies furnishing light to consumers in this city, four others are preparing to enter the field, councils having granted them the authority to do so, and two more are awaiting the Mayor's approval of their ordinances to begin work. All the companies now in operation are as follows: Brush Electric Light Company; Northern Electric Light and Power Co.; United States Electric Light Company; Philadelphia Electric Lighting Company; Wissahickon Electric Light Company; Germantown Electric Light Company; Frankford Electric Light and Power Co.; Merchants' Electric Light Company, of North Front street; Frankford Avenue Merchants' Electric Light Company; Keystone Light and Power Company; Edison Electric Illuminating Company.

The following companies have secured their desired privileges and are preparing to begin operations:

Suburban Electric Light Co.; Powelton Avenue Electric Light Co.; Columbia Avenue Electric Light Co.; Cheltenham Electric Light and Power Co.

In addition to the above, councils have passed the ordinances of the Delaware Avenue Electric Light and Power Company and the Southwestern Electric Light Company, but the Mayor has not yet signed them.

The Brush, Northern, United States and Philadelphia Companies form what is known as the Electrical Trust. The United States has swallowed up the Maxim Company, while the Electrical Trust has gobbled up the American Sectional Underground Electric Light Company, and the Penn Electric Light Company's privileges have been absorbed by the Edison Company and the Electrical Trust.

It would appear that an understanding has been reached by representatives of different sections of the city by which the electrical franchises of all Philadelphia are to be divided upon a territorial basis.

The Suburban Electric Company, which will apply to Gov. Beaver for a charter on August 11, embraces Philadelphia, Bucks and Montgomery counties in its application, and is for the purpose of furnishing light, heat and power by electricity. Hamilton Disston, Charles A. Porter, William Miller, Thomas W. Smith and Peter E. Costello are named as the incorporators. Peter E. Costello said yesterday: "We have experimented and find that we can furnish light by electricity cheaper than gas, and we will not at present go further than to supply Tacony, but as several of our outlying towns, such as Foxchase, Somerton and Torresdale, lie close to the county lines of Bucks and Montgomery, we will make our charter to embrace these counties."

The Thomson-Houston Electric Company have filed two bills in equity in the Common Pleas against the Macon City and Suburban Street Railway Company, the American Life Insurance Company, and the Real Estate Title, Insurance and Trust Company. It is claimed that about September 26, 1889, the railroad contracted with the plaintiff to furnish electrical appliances for its equipment for which it was to receive 6 per cent. twenty-year bonds out of an authorized issue not to exceed $250,000 secured by first lien mortgage. The bonds were to be taken at 90 per cent. of face value. In February and May of the present year the plaintiff received 160 bonds as security for the payment of money due. The latter, when work is completed, will amount to $55,000. The plaintiff then states that after the original agreement between it and the railroad company had been executed that the railroad company "did procure to be certified and delivered by the trustee to it 260 of said bonds secured by said mortgages above recited;" and that the railroad company did, by its officers acting in its behalf, issue and deliver the said 280 bonds to the American Life Insurance Company without any consideration whatever, and in fraud of the rights not only of said railroad company as obligor and mortgagor, but also of the plaintiff. These bonds are now held by the assignee. The bill asks that the bonds be delivered up to a receiver to be held in accordance with the agreement, or if a consideration was paid for them that on the return of the consideration the bonds be returned to the company.

The Electric Engineering Co. have filed articles of incorporation in the Camden County Clerk's office. The objects are to construct electrical railways, cars, etc. Harvey Barton, Henry Gianella, Christian Schneider and Thomas Marion, of Philadelphia, and Charles Richter, of Camden, are the incorporators. The capital stock is $100,000, of which $5,000 is paid.

The report of the Philadelphia Local Telegraph Company for the past year shows the paid up capital to be $400,000. There are 142 miles of wire, and 60 stations. The gross expenses, including $31,000 in dividends, were $64,753.04, and the gross receipts were $63,861.06. The company has invested in stock of other companies $181,990.

PHILADELPHIA, July 25, 1890.

PITTSBURGH.

Electric Railway Franchises at Braddock—Electric Mining Work—Voltage for Electric Railways.

THE people of Braddock, Pa., have been in a fever heat ever since the numerous street car lines have been chartered, to know who would be successful in securing the rights of way through the borough. There are five corporations in existence, all clamoring for the plum, and on Monday evening, July 21, all presented their claims before a meeting of councils. It is safe to say that the historic halls of the Braddock council chambers never witnessed such a scene of wrangling and general disorder. Personalities were exchanged in a very profuse, though anything but a complimentary, style, and for a time it looked as if the city fathers in their wild endeavor to defend their own company were going to pull each other's hair. The affair apparently reached its climax when one councilman accused another of holding five thousand dollars' worth of stock in one of the companies, which made him more partial to its success than anything else. This announcement created a sensation, and councils adjourned in a regular stampede. This story has one moral which ought to be a good lesson to all street railroad men in the land, to wit: "Since the introduction of the electric motor, street railway companies are paying investments, and everybody tries to get the valuable franchises for running an electric road. Therefore, get up early and secure this right before you have four or five competitors, as in Braddock, Pa."

Another coal mine in the Monongahela coal valley is being furnished with an electric equipment for the production of coal, hauling of wagons, and also to light the mine. This time it is mine No. 1 of W. H. Brown & Sons, and the apparatus is said to be the Hercules mining machine, which is being operated very successfully in several mines already in connection with the Tesla motor of the Westinghouse Electric & Manufacturing Co.

The Postal Telegraph Company of this city is laying six additional wires East and three West of Chicago. A force of twelve local electric men, under Foreman Robert Daly, are now laying the wires each way from this centre.

Supt. Morris Mead, of the bureau of electricity in this city, has served a written notice on all the electric street railway companies, telling them that they must not charge their wires with an E. M. F. higher than 800 volts. Mr. Mead has stated that this rule has been established here and has to be observed by all electric street railway companies to ensure safety to the public from their wires.

PITTSBURGH, July 26, 1890.

ST. LOUIS.

Using Electric Power for Mining Work—Increasing the Municipal Co.'s Plant—Electric Railway Figures.

THE reorganized Gold King Consolidated Mining Company, owned by James Campbell and others of St. Louis, will use electric power to operate their stamp mills and other mining machinery. Water power will be utilized. A 300 h. p. plant will be installed at a cost of about $87,000.

The Municipal Electric Light and Power Company are putting in ten 60-light Wood arc dynamos to provide for additional lights required by the city and commercial demands.

The traffic of the Union Depot railroad has increased 35 to 40 per cent. since it has been operated by electric power. The gross receipts for June were $31,751.33 ; gross expenditures, $17,062.15.

Two 80,000 watt Short generators are being installed at the power station of the Short electric railway, on the south end of the St. Louis railroad.

ST. LOUIS, July 24, 1890.

REPORTS OF COMPANIES.

AMERICAN BELL TELEPHONE CO.

The Bell Telephone Company reports an increase in the net output of instruments for the month ended July 20. The returns show 468,234 instruments in use, an increase of 36,026 over a year ago. The movement of instruments for the month and since Dec. 20, is here given :—

Month July 20.	1890.	1889.	Increase.
Shipments	4,787	4,122	665
Returned	2,887	2,390	497
Net output	1,900	1,732	168
Since Dec. 20.	1889-90.	1888-9.	
Shipments	38,364	34,338	4,026
Returned	14,991	13,671	1,320
Net output	23,373	20,667	2,706
Instruments in use July 20	468,234	432,208	36,026

It is proper to look upon the growing use of the telephone as evidence of the growth of the country. The Bell company serves the whole country, and its instruments are indispensable business adjuncts.

NEW ENGLAND TELEPHONE CO.

The New England Telephone Company has declared the usual dividend of 75 cents per share, payable August 15, to stock of July 31.

The New England Telephone Company makes a report for the June quarter, to which is added the previous quarter's returns, completing the half year. Gross receipts have recorded a fair gain, but operating cost and construction charges have eaten up the whole increase, and the result is a decrease of surplus for both periods, as shown below :

Quarter June 30.	1890.	1889.	Increase.
Earnings	$347,410	$324,707	$22,703
Expenses	264,914	230,893	34,021
Net	$82,496	$93,814	*$11,318
Construction	18,123	17,924	199
Balance	$64,373	$75,890	*$11,517
Since January 1.			
Earnings	$681,449	$624,212	$57,237
Expenses	505,799	455,385	50,414
Net	$175,650	$168,827	$ 6,823
Construction	61,051	37,687	23,364
Balance	$114,599	$131,140	*$16,541

*Decrease.

AMERICAN BELL SEVEN PER CENT. BONDS.

"Rumors of rights soon to issue in American Bell Telephone," says the Boston News Bureau, "probably originate from the fact that on August 1 the company has the right to redeem the $2,000,000 debenture 7 per cent. bonds at $110 issued to stockholders at par Aug. 1, 1888. These bonds, which are really notes of the company, were drawn for ten years, with the proviso that it could redeem them at $110 in two years or on any quarter-day thereafter. Rights to take these bonds sold at $2 each, and were in the proportion of a $1,000 bond for five shares of stock or five rights. It is doubtful if these $2,000,000 bonds are called this August. A special meeting of the directors would be necessary, as no regular meeting will be held till after August 1. The interest on the $2,000,000 bonds now aggregates $140,000. This redemption would call for $2,200,000, and it is probable that at least $2,500,000 of stock would issue upon their being called for payment. The difference between the interest on the bonds and the dividend which the issue of stock would call for, would, if put into a sinking fund, redeem the principal of the bonds at maturity. But this plum to stockholders would undoubtedly be justified by the phenomenal financial condition of the company. The bonds now sell at $112."

STOCKS AND BONDS.

ST. LOUIS.—The Union Depot Railroad Company have authorized an issue of $1,000,000 6 per cent. 10-20 gold bonds, to be ready for delivery October 1st, and the Mound City Railway Company have authorized an issue of $525,000 6 per cent. 10-20 gold bonds for delivery at the same time. The St. Louis Trust Company is named as the trustees for both issues. The entire amount, $1,500,000, has been placed with James Campbell, broker.

THE LINDELL RAILWAY CO. have increased their capital stock from $800,000 to $2,500,000.

BIRMINGHAM, ALA.—The Birmingham Railway & Electric Co. will hold a stockholders' meeting on July 26, to consider the issuance of $1,500,000 of negotiable first mortgage consolidated bonds.

OTTAWA, CAN.—The Chaudiere Electric Light and Power Co. will increase its capital stock to $500,000.

SLATER, MO., has voted bonds for $7,750, to be spent for an electric light plant.

WINDSOR, CONN.—The Windsor Locks Electric Light Co. will increase its capital stock from $10,000 to $20,000.

DIVIDENDS.

MALDEN, MASS.—The Malden Electric Light Co. has declared a quarterly dividend of 2 per cent. It has increased its capital stock from $100,000 to $150,000.

SOCIETY AND CLUB NOTES.

THE MICHAELIS FUND.

A movement has been started to raise a fund for the benefit of the family of Major Michaelis, whose untimely death was mentioned a few weeks ago. Major Michaelis, whose death was due to his efforts to save one of his children from drowning, left a wife and six children, and, like most army officers, had been able to accumulate little. His widow has taken steps towards supporting her family herself, but some of the friends of Major Michaelis wish to raise a small fund, to be invested in a house or in some other manner for her. They take this step entirely without the knowledge of Mrs. Michaelis. The committee who have the matter in charge are Messrs. Shinn, Becker, Brush, Collingwood and Bogart, of the American Society of Civil Engineers; Pope, Martin, Wheeler and Phelps, of the American Institute of Electrical Engineers. Contributions may be sent to any of these gentlemen. Several hundred dollars have already been raised.

CAPE MAY MEETING OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

Mr. A. R. Foote, Secretary of the Association, has prepared a special circular with regard to the Cape May meeting, to be held August 19, and following days, and we quote the following items of information:—

How to Get There.

Pennsylvania Railroad from New York City to Cape May.
Daily except Sunday.
Leave New York 11 A. M., arrive Cape May 4.33 P. M.
Round trip ticket good for 10 days, $6.00.
Pullman palace car fare, one way, $1.00.

West Jersey Railroad from Philadelphia to Cape May, station foot of Market street, Philadelphia.
Daily except Sunday.
Leave Philadelphia 9 P. M., 2.30 P. M., 4 P. M.; arrive Cape May 11.15 A. M., 4.33 P. M., 6.10 P. M.
Sunday train—Leave 8.20 A. M., arrive 10.40 A. M.
Round trip ticket good for 10 days, $2.00.
Pullman palace car fare, one way, 50 cents.
Steamer Republic from Philadelphia.

Leaves Race street wharf every morning, including Sundays, at 7.30; arrives at Cape May Point about 1 P. M.

Round trip ticket, good for day of issue only, $1.00.

Fare one way, 75 cents.

The Way the Time will be Spent There.

Breakfast from 6 to 10:30.
Morning session of Convention from 10 to 12.
Bathing from 12 to 1.
Dinner from 2 to 4.
Afternoon session of Convention from 4 to 7.
Supper from 7 to 9.
Orchestral Concert or Hop from 9 to 11.

The Convention will meet in the large ball room of the Stockton Hotel, capable of seating 800. This room has been placed at the disposal of the association, by the proprietor, without charge.

During the dinner hours an orchestral concert will be given in the parlor adjoining the dining-room.

For the Evening Concert or Hop the orchestra and arrangement will be under the management of the Reception Committee. The services of an orchestra of ten pieces, Mr. B. L. Faeder, director, will be furnished by the proprietor of the hotel without expense to the association.

The Expenses While There.

Special hotel rates for members of the association, their families and friends :—

1 person per day.		2 persons per week.		2 persons for the Electrical Season.	
Annex room,	$3.50.	Annex room,	$10.00.	Annex room,	$50.00
Land view,	4.00.	Land view,	42.00.	Land view,	54.00
Ocean view,	5.00.	Ocean view,	50.00.	Ocean view,	64.00

The "Electrical Season" at Cape May will be from dinner on Saturday, the 16th, to include breakfast on Monday, the 25th. This secures nine days by the sea, with but seven business days.

Carriage hire, when secured at the hotel office :—

For 2 persons, single carriage without driver, $1.00 per hour.

For 4 persons, carriage, with or without driver, $2.00 per hour.

Bathing.—For use of bathing suit and dressing room, 25 cents for each person. No other charge.

Yachting.—Boat for 12, 3 hours for $3.00.

The Way to Secure Rooms.

Rooms have already been engaged for about 150 persons—members, their families and friends. As the hotel will accommodate 1000 persons, there will be no lack of room for all who come. The use of an elevator renders all floors about equally desirable. Still, those whose applications for rooms are first received will be accommodated from the largest range for selections. Those who know Cape May best are those who most cordially recommend every one who can do so to plan for a vacation during the "electrical season" and to spend it there with their families and friends.

Letters to engage rooms, should be addressed to:—

F. Theo. Walton,
Proprietor Stockton Hotel,
Cape May, New Jersey.

If a check is enclosed to cover the price of the room for the time and number of persons desired, a receipt giving the number of the room reserved will be sent by return mail.

LITERATURE.

"THE ELECTRICAL ENGINEER'S POCKET BOOK."

D. Van Nostrand Co., of 23 Murray street, will shortly issue "The Electrical Engineer's Pocket Book of Modern Rules, Formulæ and Tables," by H. R. Kempe. The work will have numerous illustrations, and will be sold for $1.75. The name of the author is sufficient guarantee for the appearance of a work of value that will be appreciated by all members of the electrical engineering profession.

AN ELECTRIC RAILWAY 42 MILES LONG.

Hon. C. H. French, of Seattle, Washington, passed through Pittsburgh on July 24, says a special dispatch, on his way to Washington. He is vice-president and manager of the Farmers' and Merchants' Bank of Seattle, but is lately devoting most of his time and attention to the building of an electric railway between Seattle and Tacoma, a distance of 42 miles. Mr. French said :

"The road when built, and it is now well under way, will be the longest electric railway in the world. Theorists and talkers have for some years been saying that electricity is the great motive power of the future. But the people of the East and the ones who do the most talking still stick to the steam railways. We of the West are going to put the electrical way to a practical test. The road will be a fair competitor of the steam railway and at a fair distance. The route takes us through several towns of 1000 to 3000 inhabitants and numerous smaller ones, but the most of the country along the road is farming land. It is very valuable, however, and one farm right on the route recently sold for $300 an acre. We expect to use the overhead system."

OBITUARY—JAMES W. QUEEN.

We regret to announce the death of James W. Queen, founder of the house of James W. Queen & Co., 924 Chestnut street, Philadelphia, on Saturday, July 12, at Cresson, Pa. Mr. Queen, who was about seventy-eight years old, had been failing for some time, and visited Cresson in the hope of receiving benefit from the mountain air. When a boy Mr. Queen entered the employment of John McAllister, then a well-known optician on Chestnut street. When McAllister retired, Mr. Queen, together with W. Y. McAllister and Walter B. Dick, succeeded to the business under the firm name of McAllister & Co. In 1853 this firm was dissolved and J. W. Queen started at 924 Chestnut street. In 1855 Samuel L. Fox was taken into partnership. The firm is now controlled by Samuel L. and Edward B. Fox. In 1868 Mr. Queen retired from business and traveled extensively, visiting nearly all civilized countries. Until last year he enjoyed excellent health. He leaves a widow, but no children.

In the business history of Philadelphia James W. Queen's name occupies a prominent place. His reputation was of the highest and he was noted for his integrity. Mr. Queen was very skillful as a manufacturer of delicate instruments for scientists, surveyors and chemists, and his reputation in that direction was world wide. He had for a long time past represented in this country the leading European makes of electrical apparatus for measurement, etc., and had lately gone into the manufacture of such apparatus himself. Many of the productions of the house in this department are already familiar to our readers.

OBITUARY—CLARK BEERS HOTCHKISS.

Few men were better known in electrical circles than Mr. Clark Beers Hotchkiss, the organizer of the district telegraph and messenger service system in this city, who died on July 24, at Paul Smith's, in the Adirondacks.

Mr. Hotchkiss was born in Auburn, N. Y., about forty-two years ago. At an early age he came to this city and for a time was engaged in the banking business. In 1871 he organized the American District Telegraph Company, and for many years held the position of its assistant secretary and treasurer. Leaving the older company in 1881 he organized the Mutual District Telegraph and Messenger Company, of which he was vice-president and secretary, and with which he maintained a connection to the time of his death. The success of both these companies was largely due to him. He was afterwards manager for A. G. Day's Kerite.

About two years ago Mr. Hotchkiss became afflicted with consumption, and since that date he has passed most of his time in various places among the Adirondacks in the vain endeavor to regain his health. His home in this city was for many years No. 60 East Sixty-sixth Street. He married Miss Porter, of Orange, who survives him.

Mr. Hotchkiss was a man of strong build and of equally strong will, and it was largely due to his assertive nature and marked capacity for executive work that the district messenger service took its place so quickly in the economy of city life. He was also, however, a man of warm heart and kindly instincts, and leaves a host of friends rich in reminiscences of his good will toward them.

AN INTERESTING ELECTRICAL PLANT.

A recent visitor to this city, Mr. Hawks, the general manager of the Salem-Winston electric road of Winston. N. C. gives an interesting account of the road just started there. This road, which is of the Sprague overhead system, went into operation on July 15, with two cars. Between 3 p.m. and 10 p.m. the cars had earned $57.65. Next day, with the partial help of another car, they ran the earnings up to over $100, making nearly 1000 passengers per car. Other cars are being added. The road is 4¼ miles long, laid with 45 lb. Johnson girder rail. The station is a composite one of unusual character. It comprises 3 Ball engines of 385 h. p. capacity. The electrical plant consists of 2 Edison railway generators, No. 20, of 50,000 watts each ; 4 Edison incandescents of 750 lights each, and two Brush arc machines of 45 lights each. The company has a long, exclusive franchise for light and power, and bid fair to build up in a short time one of the most lucrative businesses in the whole South. The towns of Salem and Winston lie immediately adjoining each other, and the population of 12,000 is chiefly engaged in the tobacco industry, which supports a number of large factories. The place also has many attractions as a health resort, and will soon have a large hotel, reached by the electric road, and lighted throughout by electricity.

LEGAL NOTES.

ELECTRIC LIGHT TOWERS—THE DETROIT BRUSH ELECTRIC LIGHT CO. vs. THE DETROIT ELECTRIC LIGHT AND POWER CO.

A case that has attracted much attention is that of the suit for an injunction brought by the Brush Electric Light Company to restrain the Detroit Electric Light and Power Company from employing towers similar to those used by plaintiff. The proceedings were had before Judge Brown. All the five claims of infringement were denied, with the exception of the central pole as a support for the skeleton tower. This the Judge thought might be patentable. Coming down to the question of granting or denying a preliminary injunction, the opinion was substantially as follows: "I think upon the whole that a preliminary injunction in this case ought not to be granted for the following reasons: First, because I am not altogether certain that the central post is patentable, or, if patentable, that it is infringed, although my present impressions are in favor of complainants upon both those points, but I can conceive it entirely possible that upon a more elaborate hearing of this case other devices may be shown which were anticipatory of this; or I may be able to sit in connection with the Circuit Judge, as this is a matter of considerable importance, where I should not hesitate to call upon him, as his opinion may differ from mine in regard to it. Although, as I said before, if this were a final hearing I should feel compelled, with the doubts I entertain about this case, to grant this injunction and not to accept a bond. I merely throw out this intimation as a hint to the defendants to accommodate themselves to the possible final disposition of this case. In the second place, I do not think this court ought to use the process of an injunction to break up this contract. I think the court ought rather to favor the contracts into which the municipality has entered, and not use the process of the court to break them down. In the third place, the granting of an injunction in this case would lead to very serious consequences, which would result not merely in the discontinuance of this central post, upon which, as I conceive, this whole case depends, but it would involve the stoppage of the use of the entire tower and the lamps placed upon that tower. At the same time, if this were a patent upon the lamps, and I felt as clear as I do about the question of central post, I should not hesitate to grant the injunction asked; or if it were upon the tower itself, I should make a like disposition of the case; but as it merely involves the support of the tower, and as the use of those supports in itself does no damage to the complainant, I think it would be an oppressive use of the process of the court to put a stop to the entire lighting of the city by this defendant company, simply because they have used, in defiance, it may be, a post which is an infringement upon the complainants' patents. Now, what shall be the result of this case upon a final hearing? The defendant may, undoubtedly, as it seems to me, avoid the effect of this patent by extending his parallel posts to the ground. And that form of it, I presume, may be done in a large number of cases. But, I suppose, he does not see fit to do that, and it would be a question of consideration whether we would enjoin him. I can only say that my present impressions are that if the case stands as it now does on final hearing, I shall be obliged to grant an injunction. I think, however, it is open to a fair argument as to whether this does involve invention, or whether this device is an infringement, and upon the whole I have come to the conclusion to deny the injunction.

"Both sides will be allowed three months in which to prepare for the final hearing on the question of whether the central post is patentable, and an infringement on the patent controlled by the complainants."

ELECTRIC STREET LIGHTING IN NEW YORK CITY.

The session of the gas commission last week was a short one, the board adhering to its position to hold the electric light companies down to the prices of last year. Contracts for 680 lamps have already been awarded at those rates. There are 209 lamps yet to be provided, as the companies hold out for higher rates for them.

The following letter from the East River Electric Light and Power Company was received and placed on file;—

NEW YORK, July 23, 1890.

Hon. Hugh J. Grant, Mayor, President of the Gas Commission.

SIR—The East River Electric Light Company asserts in the most positive manner that it derives no profit from the city lighting at 35 cents per night per lamp, and that it would be involved in a great loss if it attempted to do underground lighting at any such price.

It further asserts that no company or individual can supply lighting cheaper with the price of labor, coal and other commodities as they are in New York. We challenge a contradiction of this statement. Respectfully yours,

JOHN J. MOORE, Manager.

Commissioner Gilroy offered the following resolution:—

Resolved, That the contract for lighting all electric lights in the city of New York, bid for on July 14, 1890, be, and the same is hereby awarded to the companies bidding, in so far as the prices bid correspond with the prices bid for lighting the city last year, until the 1st day of January, 1891, and that the secretary of this board be directed to notify the various electric light companies of the acceptance of such bids.

This was unanimously adopted, as were these succeeding ones offered by Mayor Grant and Commissioner Myers, respectively:—

Resolved, That the commissioner of public works be authorized to confer with the several electric light companies whose bids exceed the amounts paid last year, with a view to obtain such electric lighting as may come within the appropriation for the year 1890, and report to the gas commission the result of such conference at as early a date as possible; and,

Resolved, That the secretary is hereby directed to notify the several electric light companies that this board will not consent to permit the lighting of electric lamps at rates in excess of the prices fixed in the late contracts which expired on April 30, 1890, owing to the fact that the appropriation for lamps and gas and electric lighting will not admit of the lighting at rates in excess of the rates fixed in the late contracts.

After authorizing Superintendent McCormick to confer with the companies concerning the lighting of Stuyvesant Park, west, the board adjourned.

METAL AND SUPPLY MARKET.

THE UPWARD TENDENCY OF COPPER.

During last week the nominal price of copper on the Metal Exchange exceeded the highest figure reached by the syndicate in its palmy days, the quotation of July 23 being 16.90c. The electrical demand for this metal steadily increases and greatly strengthens the position of large holders. Prices bid during the week were as follows:—

21	22	23	24	25
16.75c.	16.80c.	16.90c.	16.50c.	16.80c.

The official circular of the Metal Exchange gives the following compendium statement of sales at which margins were called;—

	July 25.	July 18.	July 26, 1889.
Straits tin, spot	20.90	21.80	19.60
Straits tin, Oct	21.00	21.10	19.70
Lake copper, July	16.90	16.75	11.50
G. M. copper, July	—	—	9.00
Domestic lead, spot	4.45	4.50	3.87½
Domestic spelter, July	5.45	5.50	5.10

INVENTORS' RECORD.

Patents issued July 22.

Alarms and Signals:—*Station-Box for Watchmen's Electric Time-Detectors*, J. E. Richards, 432,645. *Apparatus for Indicating Races*, G. H. Chappell, 432,694.

Conductors, Conduits and Insulators:—*Telegraph Pole*, C. M. Brush, 432,858.

Dynamos and Motors:—*Brush Reverser for Electric Motors*, A. Reckenzaun, 432,561. *Dynamo-Electric Machine*, H. W. Spang, 432,577. *Frog for Overhead Wires*, E. Thomson, 432,581. *Welding or Other Dynamo*, E. Thomson, 432,652. *Dynamo-Electric Machine*, E. Thomson, 432,655. *Electric Motor*, H. Humbert, 432,707. *Armature for Dynamo-Electric Machines*, N. H. Edgerton, 432,748. *Automatic Lubricating Device for Electric Motors*, S. L. Barriett, 432,927.

Galvanic Batteries:—*Battery Cell*, H. E. Waite, 432,681.

Ignition:—*Electric Gas Lighter*, J. H. Lehman, 432,884.

Lamps and Appurtenances:—*Filament for Incandescent Electric Lights*, L. N. P. Poland, 432,710. *Electric Lighting System*, E. T. Cooke and W. H. Mackay, 432,745. *Electric-Light Shade*, J. H. Goehst, 432,896. *Arc Lamp*, A. H. Lucas, 432,949.

Measurement:—*Electric Meter*, E. Thomson, 432,654.

Metallurgical:—*Magnetic Separator*, G. S. Finney, 432,823.

Metal-Working:—*Electric Metal-Working Apparatus*, H. Lemp, 432,629. *Forming or Shaping Metals by Electricity*, H. Lemp, 432,630. *Method of Working Metals by Electricity*, E. Thomson, 432,651. *Method of Welding Pipes by Electricity*, E. Thomson, 432,653. *Manufacture of Bands, Rings, etc., by Electricity*, E. Thomson, 432,656. *Method of Electric Riveting*, M. W. Dewey, 432,727.

Miscellaneous:—*Electric Stop-Motion for Looms*, D. E. Coughlin, 432,512. *Electric Cut-Out*, S. D. Field, 432,521. *Phonograph*, J. P. Magenis, 432,886. *Rheostat*, T. J. Parrish, 432,894. *Heating by Electricity*, W. L. Burton, 432,962.

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TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

THE PAILLARD NON-MAGNETIC WATCH COMPANY.

The above company has recently been organized, and has fitted up very handsome offices in the Corbin Building, on Broadway and John street. Its officers are: W. W. Hammond, president; C. P. Bruch, secretary and treasurer, and A. C. Smith, general selling agent. It has just issued the following important circular:—

On the 15th day of February, 1890, by order of the Supreme Court of the State of New York, the Non-Magnetic Watch Company of America was dissolved, and a receiver appointed to liquidate its affairs. As is well known to the trade, that company had, at the expenditure of many hundreds of thousands of dollars, organized and equipped factories for the manufacture of watches and watch movements containing the inventions of Paillard; these watches have obtained so high a reputation among the trade that no reference to them is deemed necessary. Upon the abandonment of its business by the Non-Magnetic Watch Company of America, for reasons which are of no general interest except that they are in no way connected with the success of said inventions, the Paillard Non-Magnetic Watch Company was organized under the laws of the State of Illinois for the purpose of continuing the manufacture and sale of non-magnetic watches containing Paillard's inventions. This company has purchased from the manufacturers, the movements in process of manufacture at the time of the suspension of the Non-Magnetic Watch Company of America, and has acquired the manufacturing facilities formerly possessed by that company. The movements to be placed upon the market by the Paillard Non-Magnetic Watch Company will be manufactured by the same factories, contain the same inventions and be practically the same as those heretofore sold by the Non-Magnetic Watch Company of America. New grades will be added from time to time as required.

The Paillard Non-Magnetic Watch Company are licensees under the Paillard patents and no other organization possesses the right to use them. The factories having passed through the experimental stage, all movements sold by this company will be of the newest models and contain the latest improvements. Every movement is warranted and prices guaranteed.

Mr. A. C. Smith, formerly with the Non-Magnetic Watch Company of America, will continue as the general selling agent of this company.

THE NEW LIQUID INSULATING PAINT, "SEALINE."

Never before was the necessity of good insulation realized as it is now, and as a consequence there has arisen a demand for just such a compound as that now put upon the market by the Seely & Taylor Manufacturing Co., of 24 Cortlandt street, under the name and trade mark of "Sealine." This striking piece of nomenclature is a punning play upon the name of the inventor, Mr. John A. Seely, whose long familiarity with the requirements of telegraphy, telephony and electric lighting has given him an experience he has now turned to the common advantage. "Sealine" is a liquid insulating paint, which is cheaper, it is said, than other compounds intended for use in the same way. It has no bad odor, and is absolutely fire-proof as well as oil-proof. The company have already received large contracts for it, one of them being for the painting of metal roofs. It has also been found extremely useful for converter boxes, lamp hoods, moldings, etc. We have had the opportunity of examining various substances to which it has been applied, and find it to be very flexible and tenacious, neither cracking nor wearing off. We have also seen samples of ordinary underwriter's wire, to which it has been applied with excellent insulating effect. It is put up in tins, etc.

ELECTRIC CAR GEARING AND ELECTRIC ELEVATORS.

Chadbourne, Hazleton & Co., of Philadelphia, have sold to the Wenstrom Consolidated Dynamo & Motor Co., of Baltimore, Md., their patent noiseless gearing for electric street railways. This gearing will be manufactured by the Wenstrom Co. at their Baltimore factory. Chadbourne, Hazelton & Co. will be the General Selling Agents for these gears for the United States. They have also sold their patents for their electrically actuated elevator to the Wenstrom Co., by whom these elevators will be manufactured. Chadbourne, Hazelton & Co., will be the General Selling Agents for the United States.

THE ROBERTS STORAGE BATTERY AND ELECTRIC CONSTRUCTION CO.

A corporation with the above title has been formed recently in Canada to manufacture the storage battery invented and patented by Mr. W. Roberts. The company has offices at 46 Adelaide street, West, Toronto, and Mr. G. H. Macfadane is manager of the Canadian department. For his battery Mr. Roberts claims a larger output per pound of plate than can be safely drawn from any other cell. His plate is of peculiar construction, consisting of two cast plates made of a special alloy, and the active material is so held that it cannot drop out. For the heavier grades of work, a third intermediate plate is used with the two outside shells. Mr. Roberts has also a special and simple form of connection between cells so that they may be connected or disconnected in a moment. The cell is intended particularly for street railway work, and the tests made with it yield very satisfactory results.

THE EDISON INDUSTRIAL WORKS.

The Edison Industrial Works have filed articles of incorporation in the Essex County Clerk's office. Silver Lake is to be the principal place of business in New Jersey, but the company will have offices in New York and other States. The company is to manufacture, buy, sell, lease, and use machinery for mechanical, scientific, mining, and chemical purposes, and to purchase mines, factories and other property. The capital stock is to be $1,000,000, and the company intends to begin business with $150,000. Thomas A. Edison and Samuel Insull, of Orange, and Thomas Butler, of New York, are to be the incorporators.

THE UNITED ELECTRIC CO.

A recent organization is the United Electric Co., which has been formed in Cleveland, with offices in the Society for Savings Building. The company intends carrying on a general business as electrical engineers, manufacturers, agents, etc., but has a special agreement with Mr. W. E. Irish, who is known very generally in England and America as a prolific and meritorious inventor, to manufacture under his valuable patents. Mr. Irish has left scarcely a field of electrical work untouched, and has brought out telegraphs, telephones, arc lamps, incandescent lamps, motors, dynamos, street railway systems, conduits, etc. The company has incorporated with the modest capital of $50,000, and with the following officers:—W. E. Irish, president; T. D. Owen, vice-president; O. J. Campbell, assistant secretary and treasurer. With these, as directors, is associated Judge J. C. Hutchins.

THE ACCUMULATOR CO.

Under the fitting name of "The Accumulator Company," the interests represented by the Electrical Accumulator Co. have been re-organized. Mr. T. N. Vail is the president of the new corporation; Mr. D. H. Bates, vice-president and general manager; Mr. Charles R. Truex, assistant general manager; Mr. H. R. Parrish, secretary and treasurer. The company will carry on the business as before at 44 Broadway, and will be represented on the Pacific Coast by the Pacific Electric Storage Co., of San Francisco. Six storage cars have just been sold to Dubuque, Ia.; also 58 cells of 15 L type to F. M. Johnson, of Grant's Pass, Ore.; 36 cells of 15 L type to San Francisco, and 30 cells of 15 M type. The company are now prepared to fill the largest orders.

EDISON-LALANDE BATTERIES IN THE WESTERN UNION BUILDING.

The recent fire in the Western Union Building in this city, as our readers are aware, completely wiped out the battery plant, including both mains and locals. Recognizing the value of the Edison-Lalande Battery, especially for local work and its superiority over the ordinary blue-stone cell for this purpose, the Western Union Company late on Saturday afternoon, the day after the fire, ordered twenty cells from the Edison Manufacturing Co. It was too late to get anything expressed that day, but with his characteristic energy, Mr. James F. Kelly, general agent of the company, had the cells brought on from the factory by wagon, accompanied by Mr. Gladstone, superintendent of the factory, who set them up in the Western Union Building that same night.

On the following day 50 more were delivered and since then about 280 cells have been set up. These have replaced over 1600 cells of ordinary blue-stone battery, which would have been necessary.

The rapidity with which the Edison-Lalande battery can be set up and its immediate readiness for maximum work were thus brought out with great prominence on this occasion, and the promptness of the Edison Manufacturing Company in meeting the demand made upon them was no doubt appreciated by the Western Union authorities.

THE COLUMBIA INCANDESCENT LAMP CO.

The above company, of 1912 and 1914 Olive street, St. Louis, Mo., report that they are just completing arrangements to increase their capital stock. They will also enlarge their factory in order to keep pace with the growth of their business.

NEW ENGLAND TRADE NOTES.

THE PROVIDENCE CONSTRUCTION COMPANY, Providence, R. I., are at present engaged in wiring the Sakonnet Hotel, at Seaconnet Point, R. I., for a complete system of annunciator work.

MR. W. J. PILICY, agent for the Card Motor Company, of Cincinnati, has taken a new office at 74 Federal street, Boston, having removed from his old quarters at 146 Franklin street. The new office is on the ground floor, and the windows on Federal street offer a rare chance for the neat display of motor service.

MR. D. MURDOCH, traveling agent of the Baxter Electric Motor Company, of Baltimore, for the Eastern States, is paying a visit to the New England States this week, for the purpose of looking up Baxter motor interests and establishing agents. Mr. Murdoch makes his headquarters, while in Boston, in the office of Mr. Frank Ridlon, 196 Summer street, who has long been identified with the interests of the Baxter Motor Company.

THE STANDARD ELECTRIC COMPANY OF VERMONT have replaced the old Forsyth dynamo in the mill of the Franklin Falls Pulp and Paper Company, at Franklin Falls, N. H. The Forsyth dynamo was bought out by the Standard Company some years ago, but never gave good results, and is not to be confounded with the Standard dynamo, which the company are now selling, and which is vastly superior. They are gradually changing all the Forsyth dynamos wherever they can induce the user to bear the expense of the change.

THE AMERICAN ELECTRICAL WORKS, Providence, R. I., are having a continued run of good business, and in order to promptly meet their largely increasing orders, are making arrangements for a large increase to their factory. The addition will be 40 feet by 125, and will be five stories high. At present there are about 875 employees at work, and the new wing will give employment to about 300 more. The American Electrical Works are making a great specialty of very fine magnet wires, and do all their own drawing by special machinery for sizes under No. 18, and are justly celebrated for the uniformity of the diameter of these fine wires. In past years the American Electrical Works used to import the fine dies necessary for drawing the wire, but from persevering experiments, Mr. Sawyer informs me, they are now able to make the finest dies themselves. I recently saw a sample of German silver wire specially drawn and double covered with silk, to form a megohm resistance, which resembled a fine hair, and was undoubtedly a beautiful specimen of delicate work.

THE ROBINSON RADIAL CAR CO. have recently supplied the West End Street Railway Company with a new open car with twelve seats to hold 60 passengers, and it is now being regularly used on the Cambridge road, and runs around 30 foot curves with the utmost ease. The car is fitted with their new standard steel trucks, with a 14-foot wheel base, and is giving great satisfaction, riding extremely steadily and easily. They are at present engaged in building 14 more cars for the West End Company. These will probably be closed cars, as they could not be got ready for summer use, though the trucks can be used either for closed or open cars. The Thomson-Houston Electric Company have also ordered 25 radial cars with 14-foot wheel base. The Robinson Radial Car Company have just shipped an elegantly furnished electric car of the same type to the Eckington and Soldiers' Home Railway in Washington, D. C., which will be the most commodious and most luxuriously furnished and easy riding car that has ever appeared in the streets of Washington.

THE TROPICAL AMERICAN TELEPHONE CO. has acquired the sole interest in the "Hynes" annunciator drop, known throughout the United States as the "*Williams*" switch-board drop. This patent was only issued in April last, and has been pending since 1882. It covers all the drops in the "Williams" switch-boards, Mr. Howard says, and is destined to be quite a factor in the company's financial affairs, as Mr. Hynes admits that he has helped to manufacture over 35,000 of them while in the employ of Charles Williams, Jr. There are thousands of them scattered throughout the New England Telephone Company's territory, and their licensees will now, it is said, be asking how it is they are expected to pay another concern for a device sold them but not owned by the seller. The Tropical American Telephone Company, I am informed, can now manufacture its own switch-boards free of royalty and exact royalty from others for the further use of each of these drops, and these users are now being notified to discontinue their use. Mr. James Howard also hands me the following:

"The Tropical American Telephone Company wishes exporters to take notice that it is the sole authorized agent of the Inventors Bell and Blake, and no one except with its permission is allowed to sell any American Bell telephone excepting as the true destination is stated. The company, hereafter, will insist upon delivering the telephones on board the steamer which is to take the instruments abroad. The company is the sole assignee of the Hynes patent covering the "Williams" annunciator drop, and will hereafter fill all orders for "Williams switch boards" direct instead of through any other manufacturer."

WESTERN NOTES.

THE WESTERN POWER CONSTRUCTION CO. have now got settled in their new offices, and report business as rushing. They have taken orders in the past three weeks aggregating more than 1000 h. p. for complete steam plants.

MR. FOREE BAIN has just completed designs for a new motor equipment for street car work, which possesses some very advantageous features, and appears to be quite a step in advance in this line. The machines will be built right away, when their actual working will be practically tested.

COL. J. H. SHAY, of the Charles Munson Belting Company, has just returned from a trip East. He has come back as usual with his pockets full of fine orders, and he reports the demand for Munson belting on the increase all the time. This is entirely due to the remarkably fine quality and durability of their product.

MR. L. W. COLLINS, now the general sales agent of the Electrician's Time Company, 167 Dearborn street, Chicago, and formerly manager of the Chicago Electric Club, reports business as first-class and coming in to the new company from all sides. We cannot wonder at this, as the sales department is in the hands of so popular a worker as Mr. Collins.

THE HAZELTON TRIPOD BOILER COMPANY are erecting a new boiler in the cable road power house at 61st and State sts. The peculiar construction of these boilers makes them specially suited to their work, which they perform with the most universal success, and they are giving the greatest possible amount of satisfaction whereever they are in use.

MR. W. P. SULLIVAN has accepted a position as assistant to Mr. Albert Blanchard, of The Pond Engineering Company, who are doing a very extensive business in building electrical and power plants. They now have offices in most of the large cities, and will shortly open branches in other parts of the country. The company and Mr. Sullivan are to be mutually congratulated on the connection.

MR. C. H. CONE has just sold a carload of Laclede carbon batteries numbering some 5000 cells to The River and Rail Electric Company of Denver. Mr. Cone is going to place in his offices at 103 Adams street, right away, a full sample line of the famous Baxter motors, which will enable him to demonstrate on the spot to intending purchasers their many advantageous points and merits.

MR. W. R. MOLINARD, general sales agent of the Baxter Electric Motor Company, of Balkin, Ore., has been in town looking after the Chicago interests of the company. He has placed the agency for their well-known motors in the hands of Mr. Charles H. Cone, and has now returned East. He says things are looking remarkably bright with them, and they shortly expect to place some new departures in motor work on the market, which will be undoubtedly in enormous demand.

THE ILLINOIS ELECTRIC MATERIAL CO., The Rookery, Chicago, dealers in electrical supplies for electric light power and railway work, and Western agents for the Bishop White Core wires and Balata cord and the "Trinidad" moisture proof wire, have recently received some fine orders. Mr. Hoefer, the vice-president and manager of the company, has just returned from a trip in the North West, in which he caught plenty of business. Mr. E. L. Clark, the secretary, of pole-fame in Chicago, is all the time around getting orders for poles, ties and cross-arms.

THE GREAT WESTERN ELECTRIC SUPPLY CO. have the exclusive agency for the United States for electroliers made of all kinds of animals. The Elk Head electroliers at their Chicago store have already attracted much attention, and other novel features are promised by them. They are building some special racks for showing their stock of colored and cut-glass shades, of which they have the largest and finest assortment in the country. In response to the description of the Pattee Lamp Hour Recorder in the papers two weeks ago, letters are now received from all parts of the country; this shows the need of a simple meter. The specialties put out by the firm are set forth in a half dozen special circulars, all uniform in size and neatly gotten up in different colors. The series is being added to week after week and will supplement their preliminary catalogue now in the hands of the printers.

ST. LOUIS TRADE NOTES.

THE NORTH AMERICAN CONSTRUCTION CO.—St. Louis office—have contracts on hand for the equipment of 10 miles of Westinghouse electric railway at Springfield, Mo.; also an electric light plant of 1,500 incandescent and 120 alternating arc lights at the same place. They also have contracts for the installation of 715 incandescent and 40 arc lights for the Lebanon light and Water Co., Lebanon, Mo.; and 750 incandescent lights for the Belleville Electric Light and Power Co., Belleville, Ills.

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New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.
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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers*

VOL. X. NEW YORK, AUGUST 6, 1890. No. 118

The neglected borderland between two branches of knowledge is often that which best repays cultivation.—Lord Rayleigh.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

FOR the first time in its existence, the National Electric Light Association seeks the seashore. It is true that summer meetings have been held by it in New York and Boston, with little incidental seaside trips, but not before this year has the Association boldly and wisely planted its standard by the sea. It now bids all its friends and members welcome to the "summer capital," as Cape May proposes to be called.

This choice of a seaside resort is in many respects excellent, and the place itself is one of the best in the country for the purpose. Besides, there is no reason why the convention should not accomplish more work even than if it were called together in a hot and sweltering city with every condition adverse to either physical or mental activity. That the convention will be profitable and productive of good results is indicated by the length of the programme printed in our pages this week and by the nature of the topics to be brought up. Some of the papers deal with the most vital questions connected with central station management, and should invite to earnest and exhaustive discussion. Other papers and business relate to the functions of the Association itself, and nothing is more desirable than a thorough ventilation of all the matters that concern the duties and opportunities of such an important body.

Central station companies are not yet fully alive to the good they can derive from the work of the Association. If they were, the membership would be many times larger than it is. Every company of any size should be represented in its ranks and should participate in its gatherings. Each manager or superintendent has something to contribute to the fund of information and possibly something to learn; while his adhesion and support give to the work and declarations of the body the authority they need as the expression of the judgment and experience of the whole industry. The Association has done work to be proud of; it has lived down various troubles and difficulties, and it should be the common aim of all, whether local companies, parent companies, or dealers in apparatus and supplies, to give it a larger and higher influence.

ELECTRIC RAILWAYS AND OCEAN CABLES.

IT was hardly to be suspected that the disturbances caused by the introduction of electric railways would extend farther than their effects on telephonic transmission, but a recent development in another direction now claims attention, as well from the distance apart of the affected circuit and disturbing wires as from the fact that the former is a complete metallic circuit. As Mr. Cuttriss shows, the Commercial Cable Company's cable communication between this city and Coney Island is sufficiently troubled by the wires of an electric railway at a distance of half a mile to introduce false signals and to interfere seriously with testing operations. But the fact that a complete metallic circuit is employed seems to point to the conclusion that the trouble is due to conduction, or leakage, rather than to induction. True, the insulation is over 350 megohms per mile, but the potential employed on the railway, 500 volts, might be sufficient to affect, even by leakage, the delicate recorder and the still more sensitive Thomson astatic galvanometer. As yet the disturbances noted are not sufficiently great to impede the cable traffic, but Mr. Cuttriss hints at the possible consequences of an electric railway run over the same route taken by the cable. There will, of course, be a solution for the difficulty, but it will be interesting to see just what it is.

MAKE AND BREAK TELEPHONY.

THE controversy regarding the possibility of transmitting articulate speech by means of a make and break telephone, which a few years ago was carried on with considerable warmth, has now almost died out, but there remain still a few smoldering embers of those fires and they are fanned into flame from time to time by the ever-restless inventor. A somewhat novel departure in the lines heretofore worked on in this direction, and one that may revive the discussion, is exhibited in the make and break transmitter of Mr. S. D. Field, which we describe elsewhere in this issue. Mr. Field employs the makes and breaks independently of the vibrations imparted to the receiving diaphragm, and hence his apparatus may be considered a combination of a transmitter with a high speed circuit breaker. The apparatus recalls a kindred one introduced in evidence in one of the Bell suits, in which the possibility of transmitting articulate speech by means of a make and break current was demonstrated by passing the current through a rapidly revolving make and break switch. Unfortunately for the defendants, however, the demonstration was considered by the judge to have been successful, not on account of, but "in spite of," the make and break character of the current.

The judge evidently thought it more meritorious to do a thing well than to do it badly. Mr. Field, however, may consider himself clear of such a cynical criticism and all that it implies.

A Novel Burglar and Fire Alarm System.

Not a little ingenuity has been expended in the past in devising means for the protection of buildings from the invasion of unauthorized persons. These burglar alarm systems, however, have followed very much the course taken by the manufacturers of safe locks. The contest is a continual one between the burglar and the protective company, and as each improvement introduced is surmounted by the lock picker, the safe maker is obliged to introduce another in order to guard against invasion. The application of resistances as a protective and indicating measure for such systems has been made before, but a very interesting modification in their application is that described in another column, due to Mr. A. C. Robbins. By the application of the Wheatstone-bridge principle and the placing of a miniature fac simile circuit within the central station to represent the condition on the lines, he is able to locate at once any interference or abnormal condition, and the arrangement is such that by no conceivable method is it possible to keep the station in ignorance of the tampering with the circuit. This valuable addition to the protective methods, as well as its application for fire alarm purposes, seems destined to come largely into practice.

New Types of Tesla Motors.

Since Mr. Tesla read his classical paper on alternating current motors before the American Institute of Electrical Engineers, in 1888, he has devoted considerable time to perfecting these machines, and as a result has produced numerous forms, which, though having a distinct individuality, are but developments of the original idea embodied in that paper. In the present issue we describe a number of interesting forms of these later types which demonstrate particularly various interesting ways of operating these motors from a single source of alternating current by the use of two wires only. In these forms, it will be noted, Mr. Tesla obtains the necessary phase difference by shielding one of the circuits by a thin film of iron, either in the motor or in a transformer used in connection with a motor.

The River and Rail Electric Storage Car System.

The word "system" as applied to electrical apparatus in general has long since lost the force it once possessed when but few workers occupied the field and each one worked out his ideas in a manner possessing distinct individuality. In employing the word as above, however, its old meaning is recalled to us in considering the methods employed by Prof. Main in his electric traction system, which we describe at length elsewhere in this issue. Prof. Main has started out on individual lines, not only in the construction of his cells, but throughout the motor, its gearing and the other details. As will be noted, he has taken up the zinc-lead storage cell and claims to have successfully overcome all the difficulties heretofore experienced with that type, by placing the plates in a horizontal position instead of vertically. This is an interesting fact and the reasons for its adoption seem to be well grounded in observed phenomena. Prof. Main's motor is also worthy of study as embodying a type of machine which is likely to come into some extensive use, not only for continuous current work, but also for alternating. The advantages of a single magnetizing coil must be obvious, not only in regard to the cheapness of construction, but also to the uniformity of field produced in all the pole-pieces. Again, the car gear and its method of connection contains many points of novelty, and while in itself it is exceedingly simple, it is capable of meeting a variety of conditions which are of the highest importance to the economic operation of street railway cars.

Constant Current Transformer.

As remarked elsewhere on this page, Mr. Tesla has employed a special type of converter in order to obtain the necessary phase difference in his motors, but an interesting application of this type of converter is the maintenance of constant current with varying loads on the secondary. No special rules are given for the construction of this form of converter, but the general principle is described with sufficient clearness to afford a ready guide to the construction of such devices.

The Western Union Fire.

"Fine words butter no parsnips" is the blunt expression of a homely truth, and perhaps a little too harsh for the occasion, but it comes to mind as one reads the glowing terms in which General Eckert and Mr. Tinker praise their staff for the work done by it after the late fire. The compliments paid the men are graceful and evidently sincere, but seeing that many of the men lost their personal effects, while others who have been working night and day are really out of pocket by their extra work, it is only reasonable to suggest that a more tangible acknowledgment might also be made. The Western Union has lost nothing by the fire; it has, in fact, been given the chance to effect improvements that have been in mind for years, and that, when made will bring large economies in their train. Patience and loyalty are their own recompense in any employ; but where the resources are so great as are those of the Western Union Co., and where the benefit of the zeal of the staff is so immediate to the company and the public alike, substantial marks of appreciation would be proper and in order. We venture to put forward the suggestion that as medals and pensions are out of the question, a few silver dollars would not go amiss as the reward.

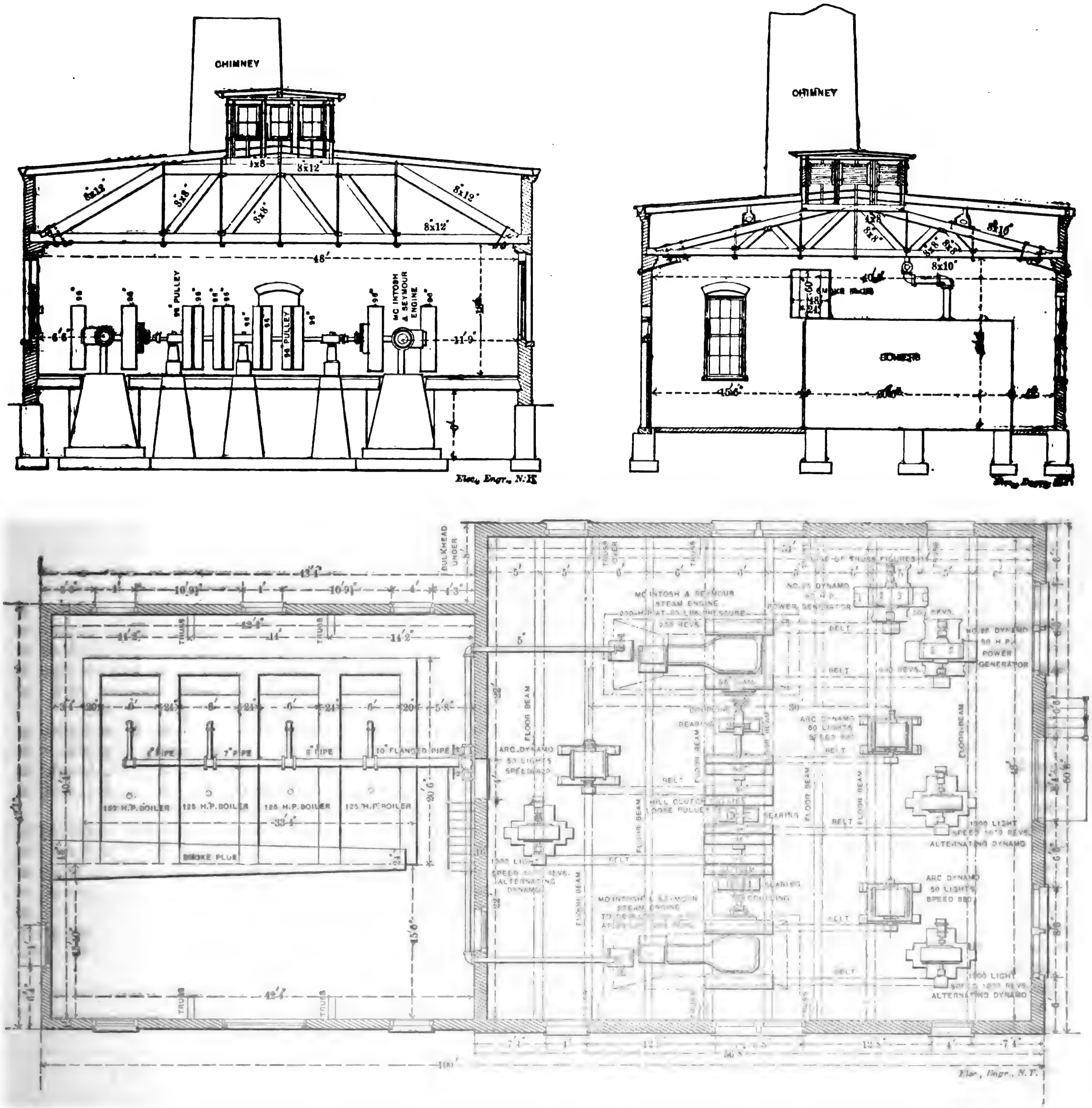
Electricity as a Scapegoat.

Mr. Wm. Maver's pithy little letter in this issue shows how silly and baseless are the accusations so often brought against the electric light wires. Another example would be the recent fires in the old Western Union building at 145 Broadway—both within a week. The first fire, in a waste paper closet, was gravely attributed to the wires. In their reports of the second fire, the papers make the statement with due seriousness that there were no wires at all in the building or in the places where the fire started. It is a pity they did not know this when in the first instance they located the wires in the waste paper closet—one of the oddest locations in the world.

NEW ELECTRIC LIGHT STATION AT NATICK, MASS.

We illustrate this week the new electric light station using the Thomson-Houston system, at Natick, Mass., which possesses some novel features in the method of driving from the engines to the dynamo. There are only a few of the more recent stations operated on the same principle, and no illustration has, until now, been published showing the details. The station was designed for 500 horse-power, though the two engines can develop about 600 horse-power. The building itself is a plain red brick structure, tastefully finished, and the foundations rest on a solid ledge of rock. The smoke stack, 100 feet high, lends quite an ornamental feature to the structure.

The engine and dynamo room, shown in plan and elevation in Figs. 1 and 2, is 48 feet by 52 feet, having a truss roof, with monitor ventilator, and is neatly finished with varnished pine, the floor being of one-inch kiln-dried birch, resting on a four-inch matched spruce flooring. In this room are two McIntosh and Seymour compound condensing engines, each of 300 horse-power capacity when supplied with steam at a pressure of 125 pounds. These engines are so placed that the crank shafts are in the centre of the room, the cylinders being towards the boiler room. The two engines, one on each side of the room, are also in line and are coupled direct to a "jack" shaft, no countershaft being used; this shaft can be run by either engine, or both engines, by means of friction clutches. The engines and the bearings of the jack shaft rest on one solid foundation. Each engine is provided with two driving pulleys, the outside pulley of each being provided with a governor, and the inside pulley having the Eclipse friction clutch. The



Figs. 1, 2 and 3.—Electric Light Station, Natick, Mass.

jack shaft is 6 inches in diameter, and carries on it four sets of tight and loose pulleys 96 inches in diameter, making 200 revolutions per minute, and giving a belt speed of 5,000 feet per minute.

The shafting and pulleys were furnished by the Holyoke Machine Company, of Worcester, Mass., who are making a specialty of this class of work, and the action of the loose pulley is particularly worthy of notice. These loose pulleys do not run in the usual manner on the shaft, but are supported by a separate bearing resting on the foundation, which has a hollow base, through which the shaft passes, and which is turned on the outside to fit the loose pulley. The pulley, therefore, does not rest on the shaft at all, and never revolves except when a dynamo is being shut down or started up, thus doing away with a large amount of useless friction and wear and tear of the pulley and shafting.

The dynamos can be placed on both sides of the jack shaft, but at present all the dynamos are being driven on the side farthest from the boilers. These consist of two 50 light Thomson-Houston arc machines, one 1300 light Thomson-Houston alternating incandescent machine, and one 80 horse-power Thomson-Houston generator for power circuits and electric railway service, should the company be granted the franchise for which they have applied. The dynamos are driven by Schieren belts, and are situated 15 and 21 feet respectively from the centre of shaft.

The switch board is of the skeleton type, and is made of varnished pine, set out so far from the wall that a man can work behind. The wires are all on porcelain knobs, and the wires from the dynamos are all conducted under the floor on porcelain knobs, being brought up through the floors through glass insulators, so that there are no wires whatever in the dynamo room, except on the switch-board and for the lamps in use in the room. In the centre of the switch-board next the floor are the arc machine controllers, surmounted by the new type of arc light switch-board set in slate. On top are the arc circuit lightning arresters. On the left of the switch-board are placed the power circuit switches and arresters, and on the right the alternating current switches, meters, and lightning arresters. The whole gives a very neat and tasteful effect, very pleasing to the eye, as well as conforming with all the requirements for protection from fire. The board is wired for three 1300 light alternators, with four circuits, and is so arranged that any dynamo can be put on any circuit, or any dynamo supply all four circuits when running light.

In the cellar among the foundations are situated two Lighthall surface condensers and heater combined, made by the South Brooklyn Steam Engine Works, South Brooklyn, N. Y., and two Knowles air and circulating pumps, each engine having a set for its own use. These condensers are controlled by a vertical shaft and hand wheel on the engine-room floor. In addition, there is a National feed-water heater, which is heated by the exhaust steam from the boiler feed, air, and circulating pumps.

The foundations are made of solid granite about three feet high, resting on solid rock, and surmounted by about four feet of brick work. Brick piers support the 6 x 12 in. beams for the floor.

In the boiler-room, shown in Figs. 1 and 3, are two 125 horse-power boilers made by the Cunningham Iron Works, of South Boston, and there are foundations for two more. They are designed to work at 125 lbs. of steam, and are fitted with the famous Jarvis setting. A Spencer damper regulator is also provided, and a Pratt and Cady steam trap, for returning all the condensed steam to the boilers. Two five-inch steam pipes convey the steam to the engines.

The smoke stack has granite foundations resting also on the rock, and is 100 feet high, and 11 feet square at the base, with a round flue 60 feet high. A curious feature about the smokestack is that it has not settled one hairsbreadth since its erection, owing to the rock foundation. The feed-water is taken from a stone reservoir which has been built about 150 yards away from the station, and which is 20x34 feet, by 22 feet deep. The discharge flows into a brook in the vicinity.

The station is conveniently situated on the Saxonville branch line of the Boston & Albany R. R., which commences at Natick, and on the railroad side there is a coal shed capable of holding 350 tons of coal.

The station was designed by the engineering department of the Thomson-Houston Electric Company, under the able supervision of Mr. H. C. Patterson; and Mr. Fone, the treasurer and superintendent of the Natick Electric Company, may justly feel proud of one of the neatest and most compact stations of it size in the country.

It is worthy of notice that the Natick Electric Company have just purchased a controlling interest in the Natick Gas Light Company, and will thus be secure from competion tending to the reduction of legitimate profits.

THE INFLUENCE OF ELECTRIC RAILROADS UPON TRANSATLANTIC TELEGRAPHY.

BY CHARLES CUTTRISS, ELECTRICIAN COMMERCIAL CABLE CO.

It would hardly seem possible that the two above mentioned industries could in any way clash, but the following account of trouble traced directly to an electric railroad will show that they do so, and that ultimately difficulties may arise which will have a serious effect upon transatlantic telegraphy, and unless some remedy is found, we may possibly have to resort to a less speedy communication between the two countries.

For many years it was the practice of cable companies to pick out some quiet, secluded spot in which to land their cables and to use land lines for the remaining distance to the nearest important city, using it as a radiating centre. This plan necessitated one transmission or repetition more than was actually necessary, and also caused a loss of time which it was very desirable to save. The Commercial Cable Company was the first to make an innovation, and in order to give quicker communication decided to land their sea cable at Coney Island, and continue it with an underground cable through Ocean Avenue and Brooklyn into the heart of this city, thereby practically making the terminus of their cable in Wall street. Past experience had shown the advisability of using a return earth circuit as far as the sea, so the underground cable was constructed with four cores laid up in the usual manner and only separated from one another by about $\frac{1}{32}$ of an inch.

The cable proper is connected to one of the cores by a permanent sea joint, and the diametrically opposite core, which is used as the return earth to the sea, is soldered directly to the sheathing wires of the sea cable, and the other two cores are kept spare in case of trouble.

This plan has given the utmost satisfaction until within the last few months, when we began to experience some trouble from occasional kicks on our receiving instrument; sometimes they would be so strong as to obliterate a signal. As these kicks are nothing unusual during the summer months, owing to thunder storms and other atmospheric disturbances, they were for some weeks attributed to such causes.

During this period it was also noticed, when testing the cable, that the mirror seemed to be very unsteady, and had erratic movements, which denoted by their abruptness that the cause of disturbance was near this end of the cable and was such as might be produced by a small fault.

To satisfy myself on this point I had the cores cut at the cable house on Coney Island, and while I was testing the undergrounds, the electrician at Canso, Nova Scotia (the distant end of the cable), was also testing the sea cable. The results showed that both the undergrounds and the cable were in perfect condition, but it was observed on the undergrounds that there was some disturbing cause in their neighborhood; as, after perfectly discharging the cores, they would in a few seconds become quite heavily

charged, always with the same potential; this phenomonon of course was only remarkable in the degree of charge. So far, we had arrived at only negative results, as the kicks, etc., were still present on joining up the working instrument.

About this time it came to my knowledge that there had recently been an electric railroad established, running from Prospect Park, Brooklyn, to Coney Island by way of the old Coney Island horse car road. Immediately it occurred to me that here possibly was the source of trouble. It must be remembered that ocean cables are operated by a recording instrument, that is so sensitive that a current of $\frac{1}{1000}$ of a milliampere will produce a distinct working signal; hence it is quite conceivable that, although the electric road does not in any part of its route approach our underground cables nearer than about *half a mile*, disturbances might be produced by the ever-varying power used in starting and running the cars. To prove the correctness of the assumption, I connected a telephone between the cable and its return earth and could distinctly hear the starting and stopping of the cars. The telephone was then connected to the cable and a local earth in the city, namely, the water pipes; the sounds then became so much louder that they could be heard with the telephone a short distance from the car. The testing galvanometer, a Thomson astatic, of course could not pick up such rapid vibrations, but it shows deflections and kicks to such a degree that we have sometimes been obliged to give up testing and try at a more favorable time, such as 1 or 2 a. m. when the cars have stopped for the night. This naturally is somewhat inconvenient.

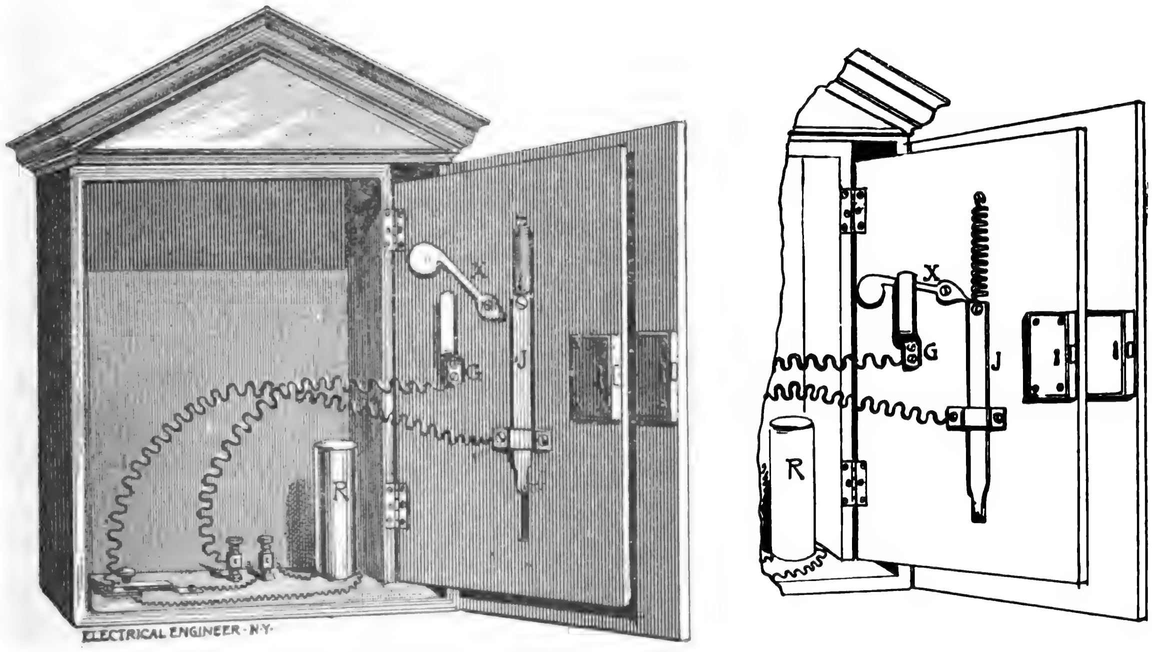
Now comes the question, if the disturbance is so severe with the railroad at a distance of half a mile or 2,640 feet, what would be the effect on the company's property if at some time an electric road should be projected down Ocean avenue where the rails would in all probability be within 4 or 5 feet of the cable for a minimum distance of 5½ miles? With telephones and ordinary telegraph instruments the use of a metallic circuit is a good protection, but in the present case it is proved that a metallic circuit through the disturbed district does not grant immunity from serious disturbance.

One point is still to be determined in regard to this phenomenon, namely, to ascertain for a certainty whether the effects produced are to be attributed to conduction through the earth and water to our armoring, or if it is an inductive effect. The fact nevertheless remains, that if electric roads should be greatly augmented in our immediate vicinity the disturbances on our lines will be seriously increased, and at present it is difficult to conceive of any remedy other than the adoption by the roads of a double trolley system.

The tests show our undergrounds to have a dielectric resistance of about 350 megohms per mile, so the idea of any leakage cannot be entertained.

ROBBINS' BURGLAR AND FIRE ALARM SYSTEM.

The various central station systems for electric protection which have been devised have either required electro-mechanical action for producing an individual signal over a connecting wire in combination with other similar alarms, or else have depended upon a variation of current through an independent connecting wire to produce an alarm. Frequently long periods of idleness, rust or dampness render the mechanical arrangement inactive when required, and simultaneous operation of two or more alarms produces conflicting and unintelligible signals. The latter method, whereby an alarm is sounded by any change in the current passing from the central office through the point protected, is, therefore, the most reliable one.



Figs. 2 and 3.—Robbins' Burglar and Fire Alarm System.

Such systems have been in successful operation for several years past, but as they indicate only a disturbance of the circuit, without rendering a specific alarm, it has been necessary to provide an independent circuit for each alarm. This is expensive, and, in instances of wire wrecks, serious complications necessarily follow, to the detriment of efficient service. In some cases a burglar alarm and district telegraph company is obliged to maintain several alarm wires for one building, in addition to their regular watchman's signal or messenger call circuit.

To obviate this difficulty a system has recently been devised and patented by Mr. A. C. Robbins, of Brooklyn, N. Y., which, while depending entirely upon variation of current for producing an alarm, locates the alarm by the quantity of variation produced, and admits of several independent alarms being worked on one central office circuit without interference, together with the usual electro-mechanical watchman's signal and messenger call apparatus. The style of alarm is immaterial, provided that it admits of a certain quantity of current being

passed through it to earth, and of different quantity to that passed by any other alarm in the same circuit. At the central office is arranged an exact fac simile of the protective circuit in its normal condition, and this miniature circuit is provided with means for readily placing it in the same condition as is the protective circuit when an alarm is sounded.

Current from a main line battery passing through the opposing coils of a differential galvanometer divides between the alarm and miniature circuits, and, both being equal, the galvanometer is unaffected, and its needle remains at zero. Any change in the quantity of current passing in the alarm circuit, however, causes a deflection in the galvanometer, which closes a local circuit, and sounds an alarm. When the fac simile circuit has been placed in like condition, the galvanometer returns to zero and the alarm ceases; a glance at the fac simile will then reveal the source of alarm, and the apparatus is then ready to receive a second alarm.

Should two or more alarms be sounded together, they are simultaneously located.

Fig. 1 is a diagram of the system, showing various combinations of alarms and mechanical apparatus. A and F are mechanical signal boxes; B, E and G represent burglar alarm resistances; C is a thermostatic, and D a municipal or street fire alarm. At the central station, M B represents the main battery; J the differential galvano-

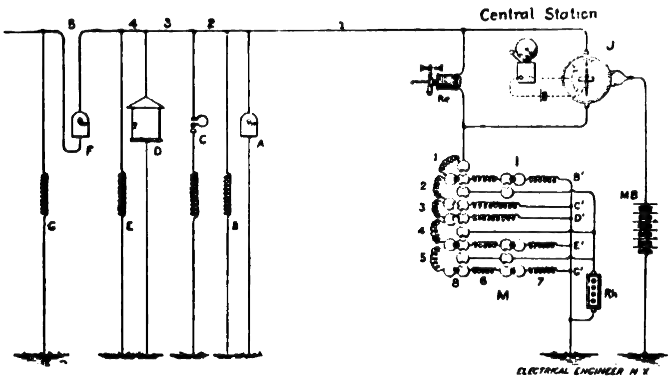


FIG. 1.—ROBBINS' BURGLAR AND FIRE ALARM SYSTEM.

meter; M being a fac simile of the external circuit in which B′, C′, D′, E′, and G′ are resistances made exactly equal to those represented by B, C, D, E, and G, and R*h* an ordinary neutral relay placed in the bridge for the reception of mechanical signals.

Now should the box A be sprung, making direct earth connection, a given number of times, the difference of potential created between the two circuits causes current to pass through the relay R*h* a corresponding number of times, and to record the signal. The box F is of the variety which opens the circuit to send the signal, and upon being sprung interrupts the circuit to points beyond F, a given number of times, produces difference of potential, similarly to the former and actuates the relay at the central in the same way.

If an alarm is sounded, and the circuits are equalized by breaking the connection at 8, in circuit G′ of the fac simile, it is evident that the branch circuit of alarm G is interrupted. Should connection with G′, at 9, produce the desired result, it will indicate that the alarm resistance of G has been shunted. If the result is obtained by connection at 10 it shows that the entire branch G has been shunted by an earth connection of no resistance.

It is impossible to produce a short circuit by an earth connection at *any* point in the circuit, as the resistances of the different sections of the protective connecting wire 1, 2, 3, 4 and 5 are compensated for by resistances at the corresponding figures at M; and the branches are likewise protected, the branch wire containing resistance in proportion to that of its alarm. Thus, the resistance of branch G, being 500 ohms, 50 ohms, or one-tenth part, are contained in the branch wire, and the remaining 450 ohms are placed as the alarm resistance. In the fac simile of branch G′, the branch wire resistance is represented at 6, and that of its alarm at 7.

Should the thermostat of branch C become heated, it closes circuit to earth, and the connection of C′ locates the trouble; likewise, the sounding of an alarm from a street box of branch D completes a similar connection to earth, and is located by connecting D′. The rheostat R*h*, in the central office, is used in locating shunts containing more or less resistance.

In locating alarms, five rapid operations, at most, may be necessary before an alarm can be located, as follows: 1, connecting for fire alarms; 2, opening of burglar alarms; 3, shunting of burglar alarms; 4, shunting of burglar alarms, and insertion of resistance; 5, locating two or more simultaneous alarms, this latter operation being a combination of the previous ones. Usually, one of the first three operations is sufficient. In practice it is desirable to replace the fac simile shown, with apparatus so arranged as to require little or no electrical skill on the part of the operator.

Municipal fire alarm telegraphs have heretofore been somewhat expensive to construct and maintain, a reliable and non-interfering mechanical signal box system costing too much for the resources of the smaller cities.

The street fire alarm box used in the Robbins system is shown in Figs. 2 and 3, and consists of the ordinary box, or casing, provided with a suitable lock for which keys are supplied to responsible people who desire them, and a second, or inner compartment, containing the apparatus, and to which access can be had only by officials possessing special keys.

The apparatus consists of a coil of resistance wire R; a special signal key K′; a rod J, moving in guide ways, and from the lower end of which a hook or pin projects outwards through a slot in the inner door; a lever X, and a contact stop G.

To signal an alarm of fire the citizen unlocks the outer door of the box, and by means of the projecting hook pulls the rod, J, downwards, allowing the lever, X, by its own weight to fall past and make connection with the stop, G, as shown in Fig. 3. The rod, J, is then retracted against lever, X, holding it securely in position. This operation completes a circuit through the coil, R, rod, J, lever, X, and contact, G, to earth.

At the central, or department headquarters, to locate the alarm, it is only necessary to turn a dial contact switch in the fac simile until it is brought in contact with the resistance corresponding to that of R in the box from which the signal emanates. If further signals are required the official in charge makes use of the key, K′, each depression of which shunts the coil, R, and produces a stroke upon a bell operated by relay R*h* at the central office.

At the conclusion of service, the official releases rod, J, by lifting lever, X, leaving the apparatus in position for future use, and necessitating removal of the contact in the fac simile, which may be understood as a signal that the fire has been extinguished.

The absence of complicated mechanism, and the extreme simplicity of this box, should admit of its being utilized even in large villages, where it is now customary to sound an alarm from the nearest church or other tower bell. The alarms being connected in multiple, the destruction of part of the branches, or of a section of the connecting wire, will not prevent the operation of such of the alarms as remain connected.

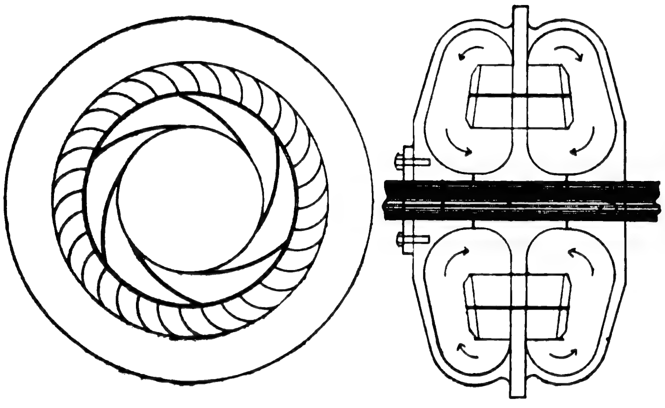
THE CHICAGO ILLUMINATING COMPANY, recently incorporated with a capital stock of $500,000, have purchased several local South Side plants in Chicago, and will continue to furnish, with increased facilities, arc lights and current for power purposes to consumers.

THE TURBINE AS AN INTERMEDIATE ELECTRIC CAR GEAR.

BY E. S. PILLSBURY.

SINCE the earliest experiments in electric traction much time has been devoted to the development of a satisfactory power transmitting device for coupling the electric motor to the car axle.

Many different methods have been tried, but at present spur gearing appears to hold the field against all competitors. Nevertheless it has many serious faults. Among the worst are the unavoidable noise and wear which occur most between the high speed armature pinion and its gear,



FIGS. 1 AND 2.—A LIQUID CAR GEAR.

and the impossibility of obtaining a variable speed ratio between the armature shaft and the car axle.

To illustrate the evils of this latter more fully, let us note the conditions that must be filled by a motor in traction work. It requires from three to five times as much pull to start a car as is required to drive it ten miles per hour. Motor builders find that in a well designed motor the torque or pull which it is capable of exerting is almost directly proportional to the current in the armature and entirely independent of the speed of the armature. From which it follows that a motor geared to a car axle and designed to develop 15 h. p. when the car is moving 15 miles per hour, is capable of developing, without overloading, just 1 h. p. when the car is moving one mile per hour and 5 h. p. when the car is moving five miles per hour. In other words, the energy available on the car axle is proportional to the car speed, while the energy taken from circuit is proportional to the traction. Thus we have the apparent anomaly that when the motor is doing the least work it takes the most current, and just before it gets ready to do work it takes from three to five times as much current as it takes when doing its maximum work on a level grade.

The above statements are made on the supposition that the field is saturated, which condition, though not always strictly fulfilled in railway work, would not materially influence the above conclusion.

However, the writer does not deem this question of efficiency so very important in practice, but this excessive starting and "coming up" current does give much trouble on small roads, where it is sometimes necessary to keep moving three times as many generators as would be required were the power used constant at its average; and even on large roads when a block occurs, as was witnessed recently, where a line of cars half a mile long all tried to start at once.

The writer wishes to draw attention to a starting and climbing device, more especially applicable to locomotives and appliances, where power is used in large units, but which may be applied to a single motor truck, and by which he believes many of the disadvantages above shown can be avoided.

Figs. 1 and 2 show diagramatically a case enclosing a turbine wheel designed to be driven direct from a motor, that is, a so-called centrifugal pump. Surrounding this, and supported by the case, is another series of turbine blades the case forming a suitable passage for the return of the liquid to the centre of the pump. Thus we have through the pump, the turbine, and returning by the passages inside the case, a complete liquid circuit, and if we drive the pump at any constant speed we shall get a speed from the turbine, varying according to the pull it is compelled to exert.

Turbines do most work and do it most efficiently at about 55 per cent. of their free speed, but between 25 per cent. and 75 per cent. of their free speed will give a very large percentage of their maximum output. As the pump is simply an inverted turbine it will follow the same laws, and hence will place in the liquid nearly the maximum amount of energy of which it is capable, while the velocity of flow through it varies from one-quarter to three-quarters of the velocity when there is no back pressure. Now it will be seen that if the pump forces into the liquid nearly the same amount of energy while the velocity of flow through it varies in the ratio of one to three, and if, when supplied with any given velocity of flow, the turbine is capable of developing nearly the same amount of energy while its speed varies in the ratio of one to three, then we may expect from the combination, the speed being constant at the pump, that the speed of the turbine can vary in the ratio of one to nine, the pull being somewhere nearly in inverse ratio.

In regard to the output for a given size of machine we can only say that high speed turbines are very powerful in proportion to their size, a 15-inch wheel of modern design being rated at about 350 h. p., running at from 600 to 700 revolutions per minute.

In Fig. 3, attached to the starting device, is shown an electrically actuated friction clutch, *a a'*, by which, when the car has attained any given speed, the driving and driven turbines will be automatically coupled together and the car driven direct from the motor through a bevel pinion and a pair of bevel gears. Two clutches, D and E, which may be actuated either electrically or mechanically, are shown for coupling the axle to the bevel gears, thus driving the axle in either direction without reversing the motion.

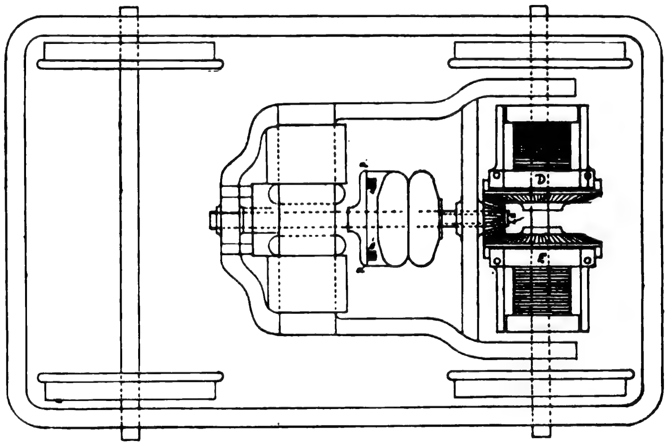


FIG. 3.—A LIQUID CAR GEAR.

With this method of transmission the car may be controlled entirely by one switch, and if reversed while running at full speed the motor will not be overtaxed; in fact, the car might be entirely controlled by the clutches on the axle.

Though it is not considered necessary to claim for this starting device a high efficiency, yet it is believed that if laid out so as to introduce those features which have rendered the modern turbine among the most efficient of prime movers, and considering the fact that we are here enabled to escape the most serious loss of the turbine, namely,

energy retained by the water on leaving the wheel, as well as the fact that a liquid introducing less friction than water may be used, we may find it a very efficient means of continuous transmission for certain kinds of work.

THE RIVER AND RAIL ELECTRIC STORAGE CAR SYSTEM.

There has now gone into operation on the dummy road in South Brooklyn the electric storage car of the River and Rail Electric Light Co., of this city, which claims attention on account of the number of novel features involved in its operation and construction, constituting a marked departure from the usual practice.

Before entering into a description of the car itself, it may be well to take up first the element from which the power is derived, namely, the storage battery. This, as every other detail in the system, is due to Professor Wm. Main, who has been for a long time engaged in its development. The battery itself is what is known as a zinc-lead storage battery. Our readers will remember that early in the art M. Reynier experimented with this type of cell, using the zincs as the negative plates, but the results which he obtained were not sufficiently encouraging to warrant the general adoption of this type. The results of Prof.

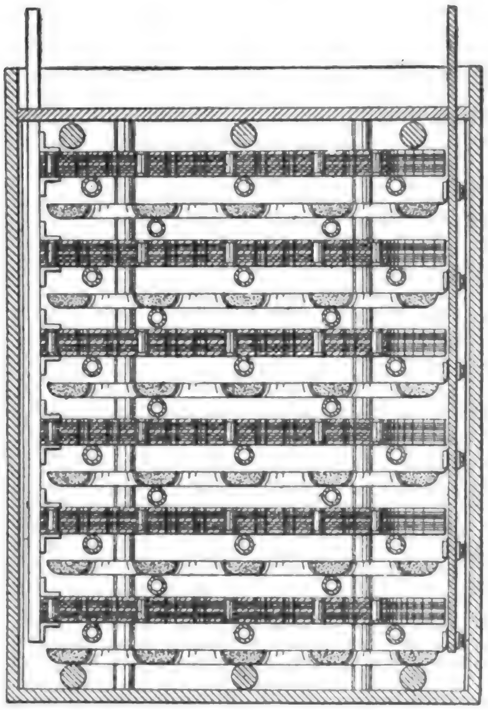


Fig. 1.—The Main Storage Battery.

Main's experiments in this direction, however, soon convinced him that the difficulties encountered by M. Reynier were attributable mainly to the fact that his plates were disposed vertically in the solution. The result of this arrangement was that the zinc plates, on account of the difference in density of the solution at various points, were unequally acted upon, and indeed frequently cut away. This phenomenon is also noticed in primary batteries in which zinc is employed, and in which the part at the bottom of the cell is usually eaten away considerably faster than that at the top. The natural remedy for this defect was recognized by Prof. Main and applied by placing the plates in a horizontal position, so that, notwithstanding differences in density of the solution, each separate plate would be surrounded by a layer of solution having the same specific gravity throughout.

The arrangement adopted is illustrated in Figs. 1 and 2, which represent the cell in vertical and horizontal section respectively. The positive or peroxide plate, it will be seen, consists of two outer sheets of lead, between which is placed a layer of sheets of thin lead foil. The plate is perforated, as shown in Fig 3, and riveted together at numerous points. This plate, when placed in the battery and worked for a short time, is acted upon so as to convert the lead foil into peroxide, which is firmly held in place. The negative plate, which is shown in Figs. 1 and 2, consists of a copper tray perforated and into which amalgamated zinc is poured so as to completely fill the tray, as shown in Fig.

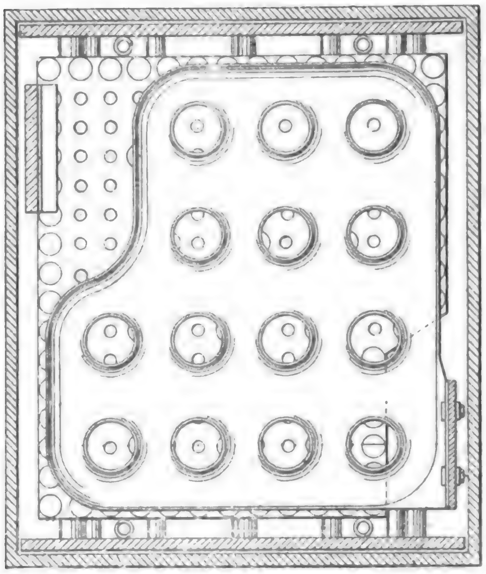


Fig. 2. The Main Storage Battery.

1. A very small number of charges and discharges serve to convert the zinc amalgam into a highly porous and spongy mass, having a great property of absorbing hydrogen. The cell employed on the car has 14 plates and weighs 45 pounds, of which 27 pounds is the weight of the metal proper. It has a capacity of 250 ampere hours; 60 of these cells are employed on a car.

The action of the cell under charge and discharge is well shown in the curves, Figs. 4 and 5, which give the results

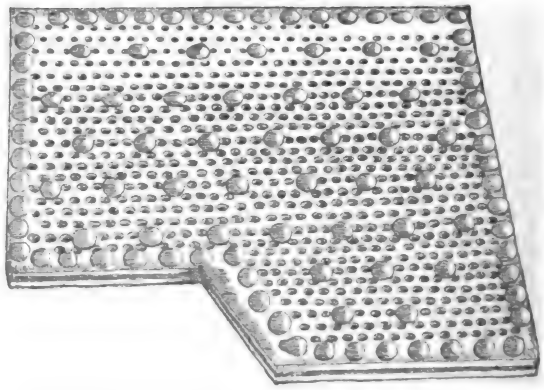


Fig. 3.—Positive Plate of the Main Battery.

of some recent tests and are sufficiently clear without further explanation.

Having described the battery, we may next take up the car itself. Our illustration, Fig. 6, shows the car complete as it stands on the track. Its distinguishing features are the rounded ends which furnish the space in which the motor man is placed so as to leave a clear passage for the entrance and exit of passengers. In this space are the controlling switch and lever and the brake placed conveniently for the manipulation of the motor.

The essential feature of every electric car, the electric motor and the gearing, deserves in this instance special consideration, as both these elements have been worked out by Prof. Main on entirely new lines from the practice here-

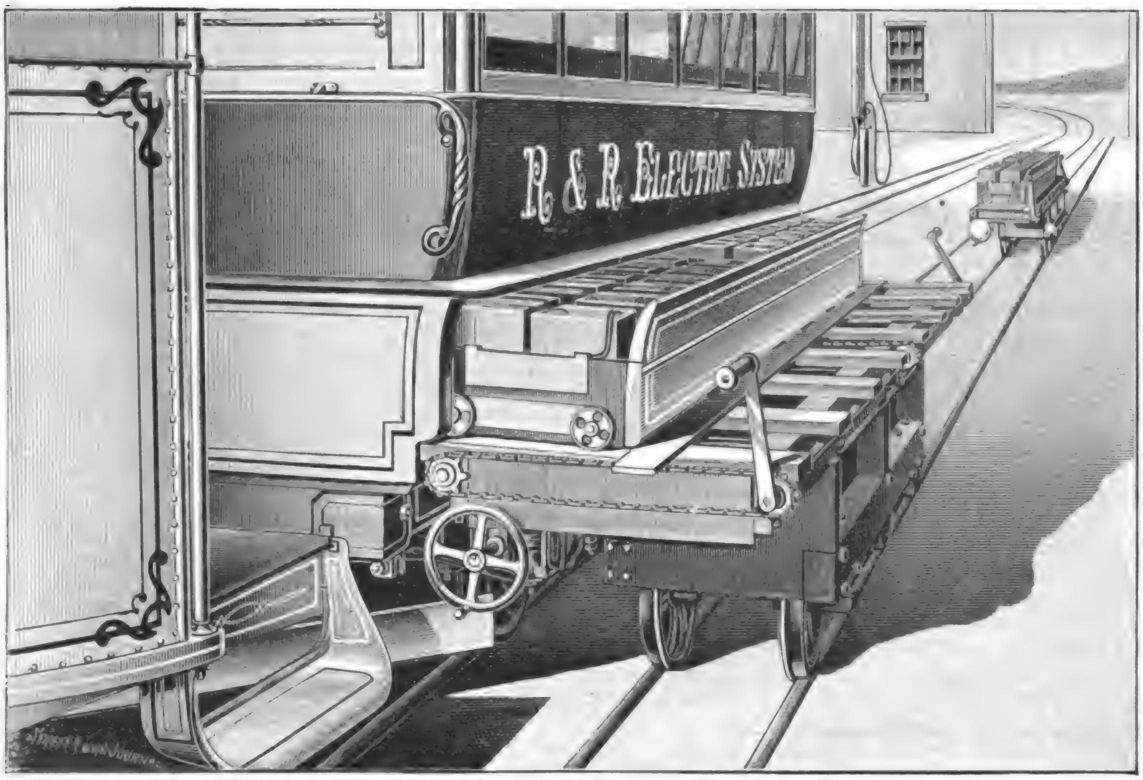


FIG. 10.—METHOD OF CHANGING BATTERIES, RIVER & RAIL SYSTEM.

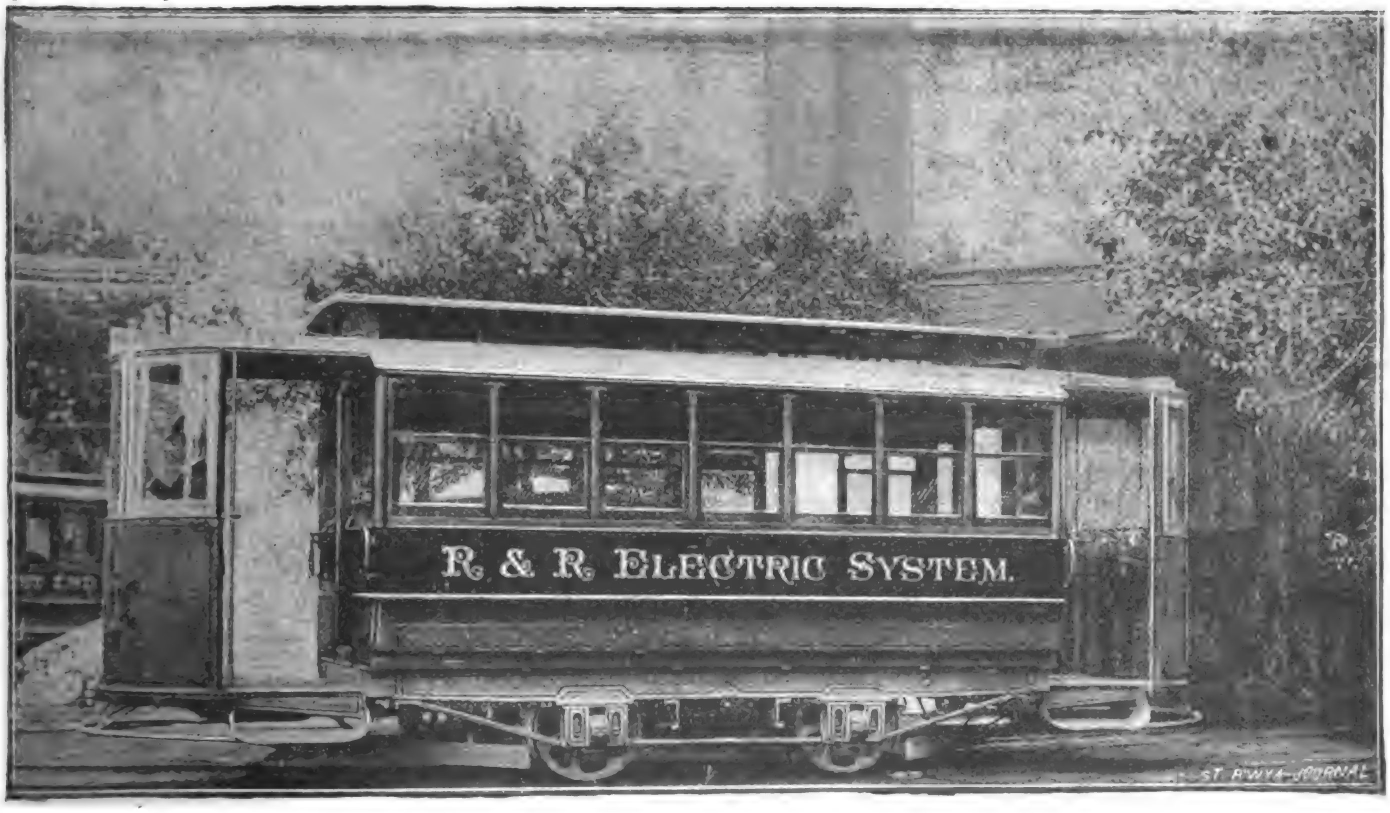
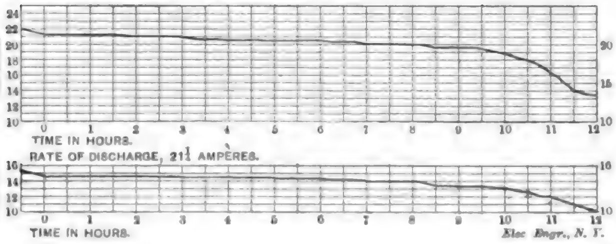


FIG. 6.—THE RIVER & RAIL ELECTRIC CO.'S NEW STORAGE BATTERY CAR.

tofore in vogue. Prof. Main was among the first to recognize the fact that increased economy could be obtained by an arrangement in which the motor is kept revolving at a constant speed, and at which it operates at the greatest efficiency. At the same time he recognized the fact that an element of almost equal importance is the nature of the gear connecting the motor with the axle.

Taking up the motor first, Prof. Main was among the



FIGS. 4 AND 5.

first also to develop the design in which the armature is kept stationary and the field magnets revolve, and he has carried this still further in maintaining the wire on the field magnets also stationary, so that in reality there are no moving wires whatever on the motor. The latter is shown in perspective in Fig. 7. Prof. Main has adopted the multipolar type of machine with a particular arrangement, which is clearly shown in section in Fig. 8. Here, it will be seen, the armature A is held stationary by the casing and is surrounded on both sides by field magnets, one of which is shown at N N; opposite to this is a wood filling, the object of which will be explained presently. Placed at right-angles to the poles N N is a similar pair, having an opposite or south polarity. The filling shown opposite the poles N N is of wood, the object being to fill up the spaces between the two arms of each pair of magnets in order to avoid churning of the air and so as to give smooth working.

The core of the magnet D, it will be seen, is mounted directly upon the shaft of the armature and is surrounded by the magnetizing coils, which are placed in the cylindrical casing marked M M. This casing is stationary, as is also the magnetizing coil. The result of this construction is that both pair of poles of the magnetic system are influenced by a single magnetizing current, and hence are of a uniform strength, so that the action of each pole upon the armature is identical.

Another object secured by this construction is the shortening of the magnetic circuit. It will be understood from what has been said, that the lines of force emanating from both north poles, N N, for instance, pass into the armature A, travel through and along it for the distance of one-fourth of its circumference and then pass out to the other side into the south poles and back through the core to the other side again.

The armature is built up of specially rolled soft ribbon iron, wound spirally, the different convolutions being separated by insulating material; the ring is wound in Gramme fashion, with special connections on account of the employment of four poles. The commutator also remains fixed, the brushes alone revolving. The motor shown and employed on the car revolves at 800 revolutions per minute, which corresponds to a speed of 12 miles an hour for the car.

The motor is directly connected with the driving mechanism, which is shown in perspective in Fig. 9, and which constitutes a radical departure from the methods heretofore employed in electric car practice. As remarked above, the motor is kept in continual revolution, and hence some gear must be employed in which starting and stopping can be accomplished without shock. This has been accomplished by Prof. Main by the employment of a peculiar gear, which is based upon the sun and planet motion, with some essential modifications. The central shaft of this gear, which is directly connected to the motor, revolves at all times with the speed of the latter. Two portions of this shaft, however, are slightly eccentric and have loose pinions mounted upon them, which mesh at all times with the internally toothed gears which surround them. These pinions may revolve idly with the gears, or may drive them, according as they are allowed to gyrate with the eccentric and revolve, or to gyrate only, the pinions being connected by double gimble joints to discs concentric with the central shaft. Each disc will therefore revolve with its pinion when idle; but when arrested by the grip jaws, operated by means of the beveled gear wheels and shaft shown, they will cause the pinion to drive according to the direction in which the beveled gears are turned by the motor man; either one pinion or the other will drive, with the result that the car can be driven at two different speeds, slow and fast, notwithstanding the uniform speed of the driving motor. By releasing both grip jaws, neither pinion drives, and the car may be brought to a standstill with the motor revolving at full speed.

These operations of clutching are performed by the motor-man by means of a lever on the platform. The two internally toothed gears are connected permanently to each other and to the double sprocket which drives both chains, and action comes from either one or the other, or from neither, as the case may be. The driving sprocket wheels are connected to either axle so that both are driven direct. The whole mechanism is lubricated automatically from within by centrifugal action. The oil, as it drops down, is caught in a pan which encloses the whole under the car, and by means of a loose traveling ring returns to a reservoir and is used over and over again. The friction on the gimbal joints is exceedingly small, the motion of the rubbing surfaces being reduced to a small fraction of an inch, and as the internal gears mesh over a considerable part of their cir-

FIG. 7.—THE MAIN MULTIPOLAR CAR MOTOR.

cumference, and are in addition completely flooded with oil, as well as protected from dust, their life is also indefinite.

In order to avoid all shock on starting the car, the sprocket wheels attached to the axles are mounted on drums which contain springs so arranged as to keep the chains taut and to receive the first impulse in starting. The action of the spring is to allow a certain amount of relative motion between the two axles, thus avoiding the hard driving action experienced when both axles are geared to one motor. The tractive power is therefore utilized without rigidity, so that the mere momentum of the motor, after the current has been shut off, and with the car standing, is able to start it and to propel it some

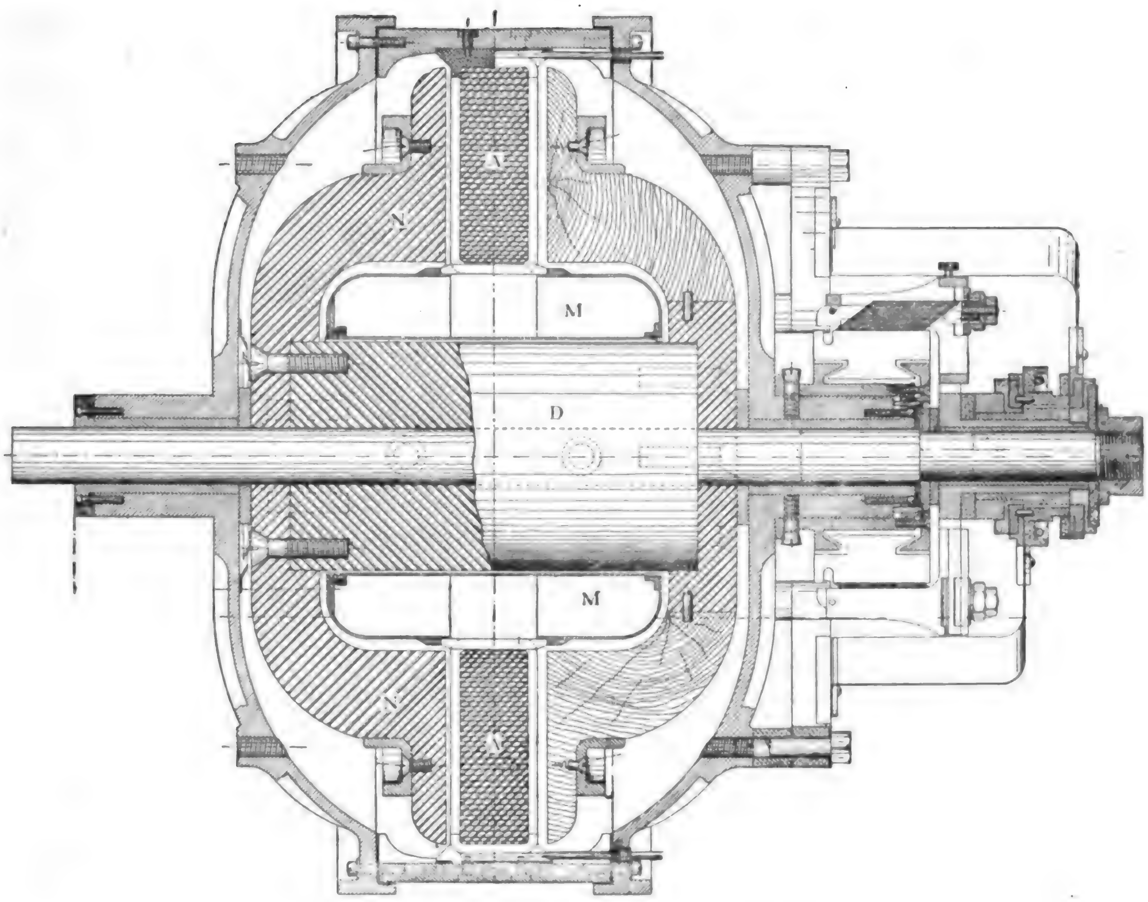
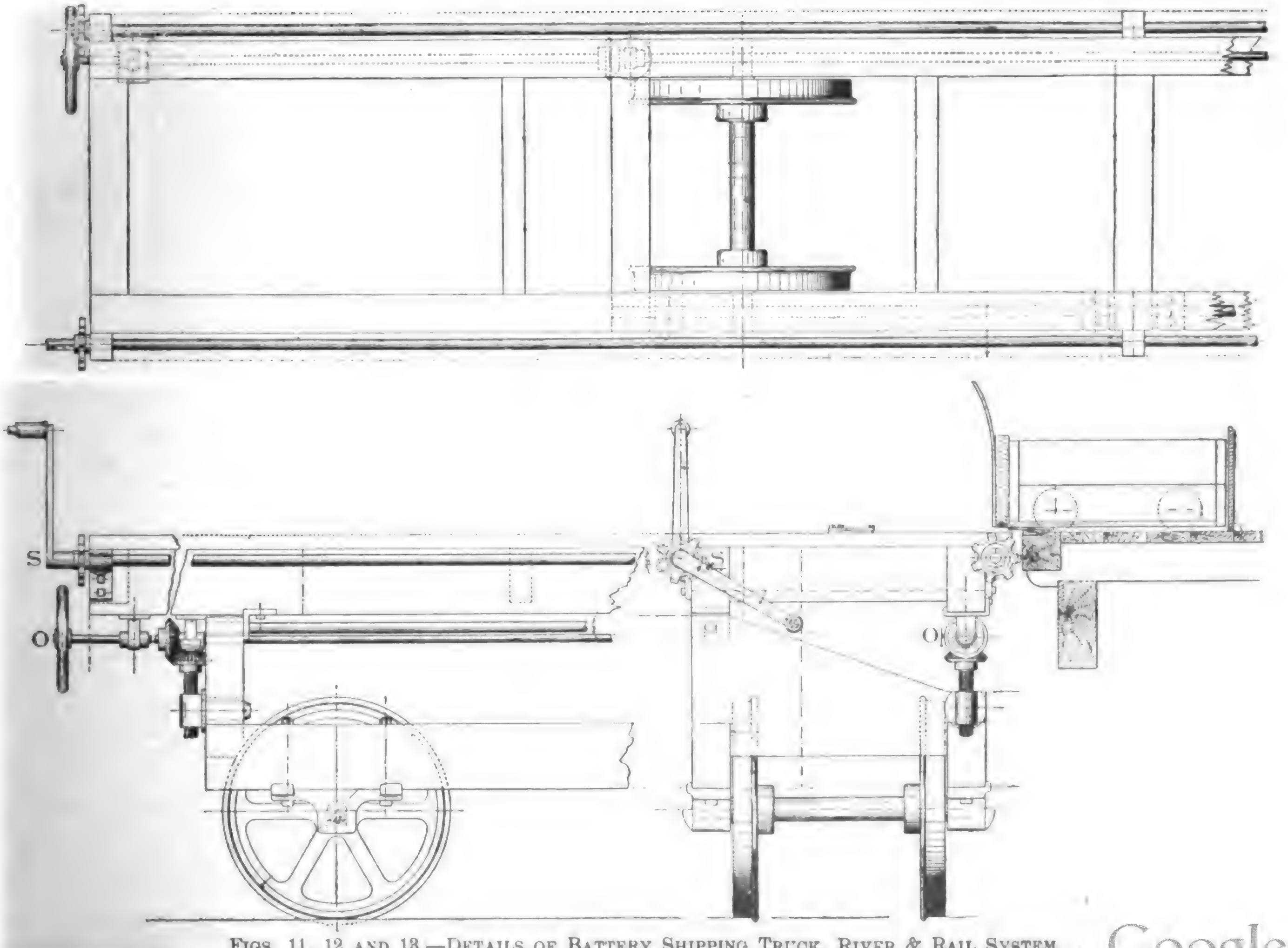


Fig. 8.—Section of Main Multipolar Motor.



Figs. 11, 12 and 13.—Details of Battery Shipping Truck, River & Rail System.

distance. Provision has also been made for securing the pedestals of the car so that the wheel base can be slightly increased to take up any stretch in the sprocket chains which may occur.

These constitute the principal elements of the car, but it remains still to describe the method employed for taking out and replacing the discharged cells from the car. The arrangement employed for this purpose is illustrated in perspective in Fig. 10. Parallel with the track on each side of the car, as shown in the illustration, are narrow gauge tracks, on which a small platform car runs, the height of which may be regulated by means of the handle o, shown in detail in Figs. 11, 12 and 13. It will also be noticed that the battery cells are mounted in trays provided with wheels and fitted with latches to hold the cells in place. On top of the shifting table there is placed an iron bar extending along the entire length; the front of which, as shown in Fig. 13, has raised pieces so spaced as to come opposite the latches in the trays so that when the bar is brought up under them the latches are raised and the cells can be rolled out directly upon the platform. To remove the batteries at the same time these projections enter into engagement with shoulders on the latches and by means of the cranks, s s, shown in Fig. 13 and in perspective in Fig. 10, the entire series of cells can be drawn out at once. It will also be noticed that the cove panels of the car are removed with the cells, constituting, in fact, one side of the tray, a proceeding which is entirely permissible on account of the construction which is employed. The cells are immediately placed in circuit for recharging by flexible wires connected with copper bars above, which slide in slotted tubes, to the generator. Connection may thus be made with the cells at once and the cells wheeled off without any delay.

Prof. Main has devoted a large amount of attention to the working out of the details of this system, and the results already obtained with the car now in operation are of the most encouraging nature, and have attracted the general attention of street railway people, especially those engaged in work in towns and cities where the feeling against overhead wires is strong.

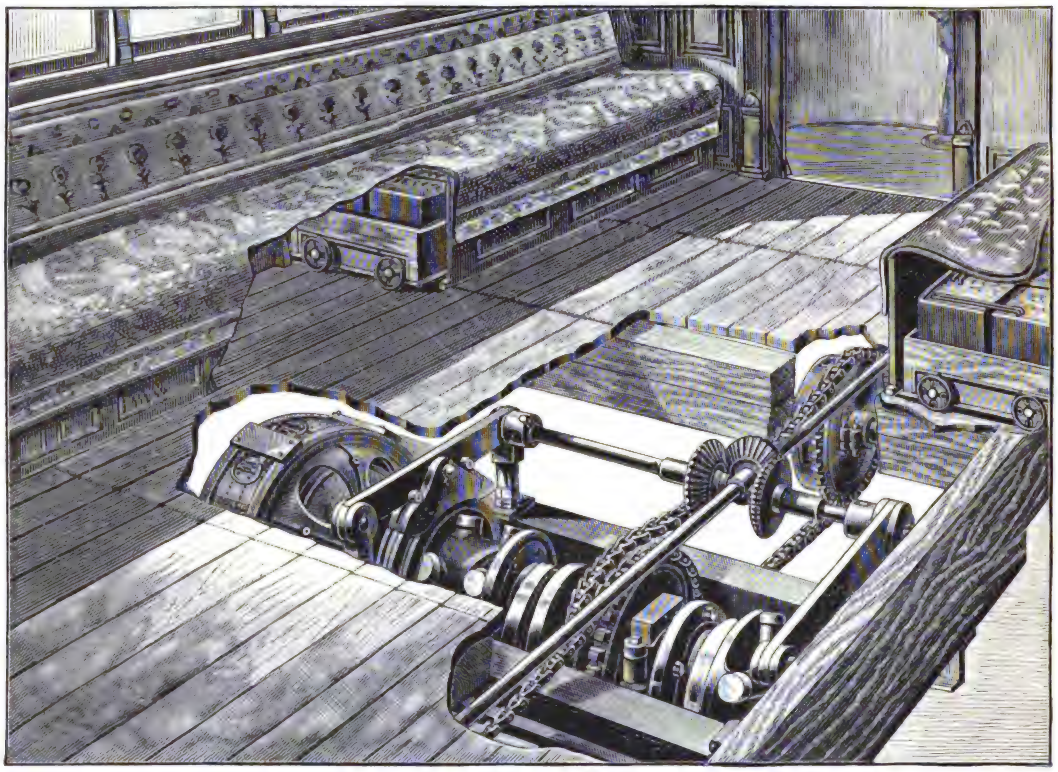


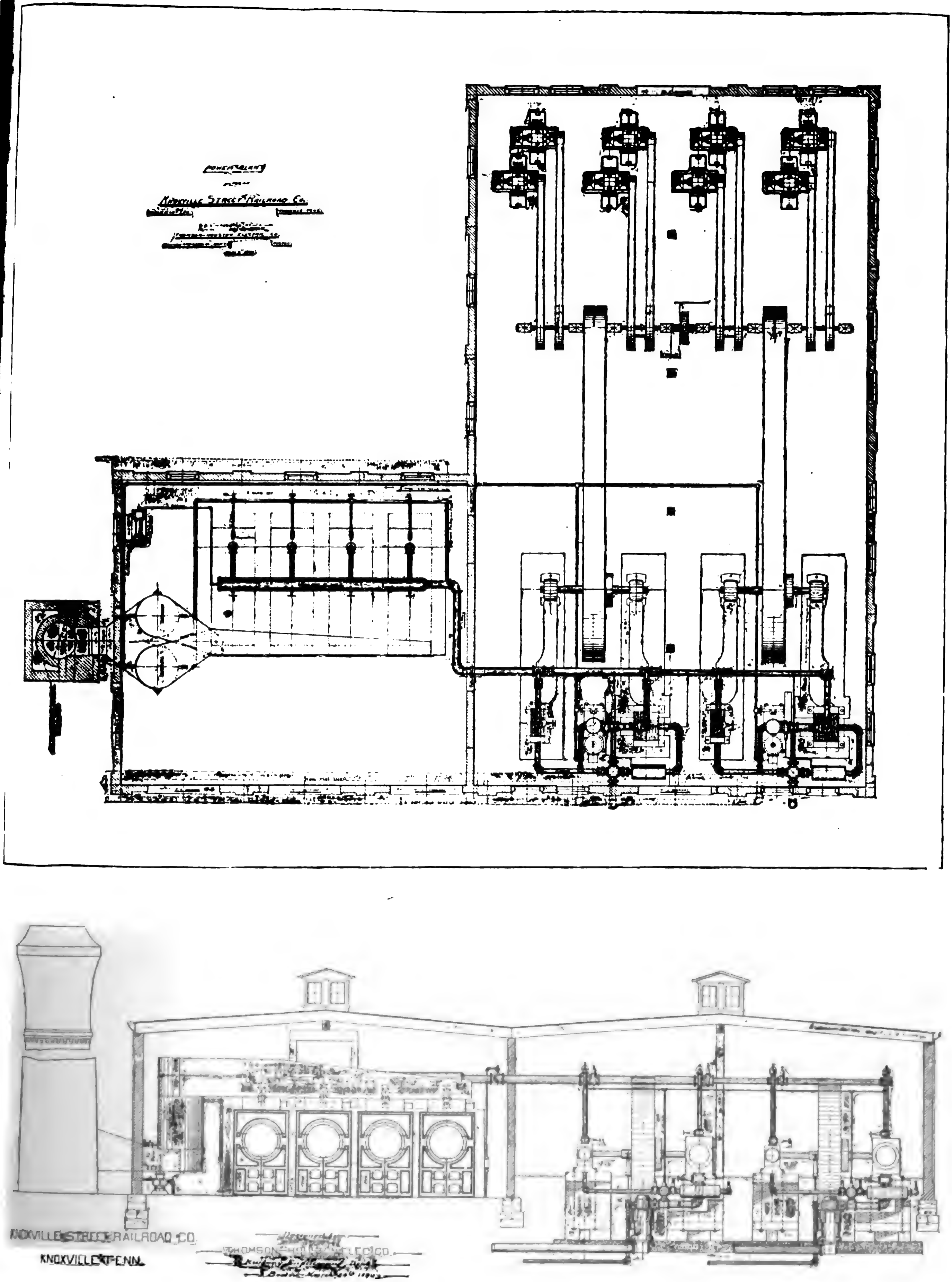
Fig. 9.—Driving Mechanism of the River & Rail Storage Car.

POWER STATION OF THE KNOXVILLE STREET RAILWAY CO.

One of the recent installations made by the Thomson-Houston Electric Co. is shown in the accompanying illustrations of the power station built for the Knoxville Street Railway Co., Knoxville, Tenn. The drawings, Figs. 1 and 2, are the plan and section, of the elevation, from which the construction of the station and the disposition of the apparatus can be readily seen. The building is one story, brick, and divided into boiler and engine and dynamo rooms. The steam plant consists of four steel tubular boilers built for high pressure to be operated at from 115 to 125 lbs. pressure, with furnaces designed for burning a low grade of slack coal. Economizers are also provided for utilizing the waste gases in bringing the feed water up to the boiling point before it is pumped into the boilers. Four ways of feeding the boilers are made use of and so arranged that in case of accident to any one of them, the operation of the steam apparatus would in no way be impaired.

The engines are of the cross-compound condensing Corliss type and so arranged that each pair, which is considered as one engine, can be operated as a twin engine, and in case of accident, either side can be run alone. Each side can also be worked high or low pressure, so that provision is made for operating the plant, even though half of the engine is undergoing repairs. This is the first plant of this kind in the world which has been erected for electric railway purposes, and very satisfactory results are anticipated from it. Each engine will carry its full load, under the varying conditions of railway work, on an evaporation of 18 lbs. of water per horse-power per hour. The engines are of extra large proportions throughout so as to withstand the severe service incidental to railway work.

The electric apparatus comprises eight Thomson-Houston railway generators, and the usual appliances for their operation. Each generator, as is the same with the engines, is arranged so as to be thrown in or out of action without interfering in the least with the operation of the remainder of the plant. The engines, boilers and piping were furnished by C. & G. Cooper, of Mt. Vernon, Ohio, and the



FIGS. 1 AND 2. POWER STATION, KNOXVILLE, TENN., ELECTRIC RAILWAY.

counter-shafting by the Holyoke Machine Co., of Worcester, Mass. The plant is rapidly nearing completion and will be in operation some time this month. The installation was designed by Mr. L. H. McIntyre, of the Railway Engineering Department of the Thomson-Houston Electric Co. The electric railway for which this plant is designed is 3.40 miles in length and will operate five motor cars.

FIELD'S MAKE AND BREAK TELEPHONE.

Mr. Stephen W. Field's work in the various branches of telegraphy and electric railroading is probably well known to our readers, but his versatile genius has also led him in the direction of telephony. One of the results of his work here has been the production of a telephone which automatically makes and breaks its circuit with a rapidity too great to be perceptible to the ear; he combines this with a diaphragm in such a way that sound waves projected against it are caused to bridge over the makes and breaks to a degree exactly proportional to the sound waves' rapidity of succession.

The accompanying engraving, Fig. 1, shows two such diaphragms, D and M, supporting respectively two contact points, E and G. One diaphragm is supported above the other and is kept in a state of tension by connection with a fine wire, C, of considerable resistance.

It will be seen that the circuit of battery, B, passes normally through the insulated metal frame, J, of the telephone, and the wire, C, to the diaphragm, D. It will also be observed that there is a short circuit, by way of the wire I, between the contact point, G, and the frame, J. The strain of the wire, C, is normally sufficient to separate the contact points, E and G, but when the switch, A, is closed and the current from battery, B, traverses wire, C, the latter will elongate and allow the points to come in contact.

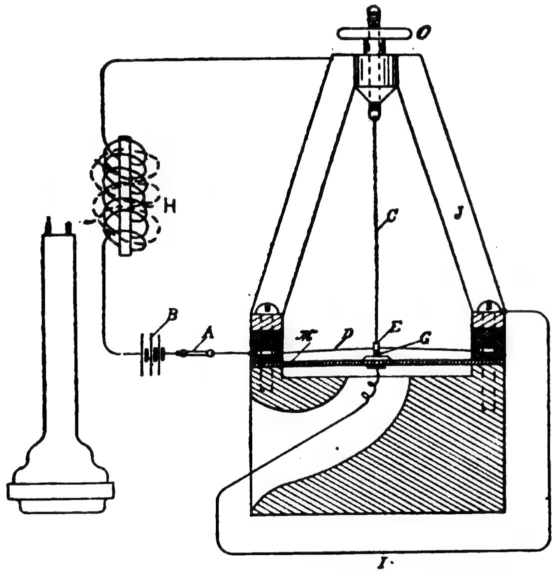


Fig. 1.—Field's Make and Break Telephone.

The current will thus be shunted around wire, C, through a path of approximately no resistance, with the result of cooling and contracting C and separating the contact points.

The function of the device is, in fact, that of a circuit-breaker of such rapid action under the influence of the current of the battery, B, that the vibrations are outside the receptivity of the ear. It follows that the sound waves striking the diaphragm, F, will alter the relative positions of E and G, and tend to prolong their contacts, making audible, and, if in proper sequence, articulate speech.

In Fig. 2 is shown an arrangement for applying the same idea to a carbon transmitter for the purpose of increasing its sensitiveness. In this construction the carbon, which is mounted on the diaphragm, is kept in contact with a corresponding platinum contact-piece by means of a fine wire under tension attached to the diaphragm. The contact expands the wire C, thereby tending to break the circuit; but the consequent cooling of the wire contracts the same and closes the circuit.

With the construction here illustrated an equilibrium is set up between the elongation of the wire, C, and the resistance at the carbon contact, the result being that the pressure of the carbon is kept automatically at the most delicate point and a self-adjusting carbon transmitter is obtained. The changed thermostatic condition of the primary circuit is brought about in this construction by a rupture of the circuit, due to the elongation of the resistance-wire, or, rather, by an increase in the resistance of the circuit, and not, as in the other form, by the introduction of a shunt around the resistance-wire.

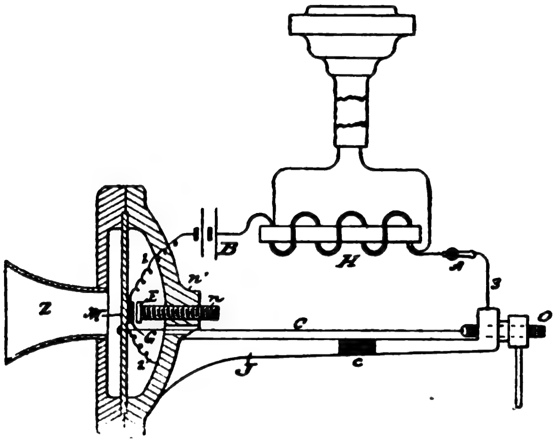


Fig. 2.—Field's Make and Break Telephone.

The makes and breaks of the automatic circuit-breaker produce no audible effects upon the circuit by reason of the great rapidity with which they follow each other. That is to say, the normal vibrations of the circuit-breaker, considered with respect to their capacity to reproduce sounds, are neutral or inharmonious. That which reduces them to harmony and enables them to reproduce sounds is the combination, with the apparatus which produces them, of devices which bridge over or throw together more or fewer of the inharmonious vibrations and thus alter their natural sequence.

RESISTANCES FOR STRONG CURRENTS.

M. Hess, in *La Lumière Electrique* calls attention to certain considerations in the design of resistances for strong currents. In making coils for resistance tests the choice of a material having a low temperature coefficient is very important; but this is not usually the case with coils intended to stand strong currents, nor indeed is high specific resistance a desirable thing. M. Hess shows that if two coils of equal resistance are designed to stand the same current without rising above a given temperature, the coil of higher specific resistance is shorter, while the diameter and volume of the conductor are greater; the ratio in all three cases being the cube root of the ratio of the specific resistance. Thus, if the second coil has 27 times the specific resistance of the first, its length is one-third that of the first, while the diameter of, and the volume occupied by, the wire are each three times as great. Unless, therefore, the second material costs only one-third that of the first, it is cheaper to construct the coil of the better conducting substance.

The Pond Engineering Co. have now opened branch offices in Seattle, Washington, and Dallas, Texas. This company, who make a specialty of constructing steam plants for electrical and power purposes, now cover the West very thoroughly and are doing a large and increasing business.

TESLA'S NEW ALTERNATING MOTORS.

For some time past Mr. Nikola Tesla, whose previous work in alternating current motors is well known, has been engaged upon the study of these machines in order to develop efficient methods for operating them on two wires instead of three, and still without the use of a commutator.

The general principle upon which these machines are designed is based on the well-known fact that if a magnetic core, even if laminated, be wound with a coil and a current be sent through, the magnetization of the entire core does not immediately ensue, the magnetizing effect not being exhibited in all parts simultaneously. This Mr. Tesla attributes to the fact that the action of the current is to energize first those laminæ or parts of the core nearest the surface and adjacent to the exciting coil, and from thence the action progresses towards the interior. A certain interval of time, therefore, elapses between the manifestation of magnetism in the external and the internal sections or layers of the core.

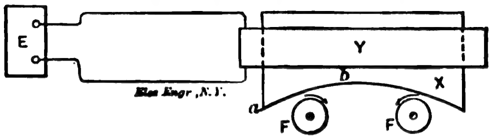


Fig. 1.—Tesla Alternating Motor.

If the core be thin or of small mass this effect may be inappreciable, but in the case of a thick core, or even of a comparatively thin one, if the number of alternation be very great, the time interval occurring between the manifestations of magnetism in the interior of the core and in those parts adjacent to the coil is more marked, and in the construction of such apparatus as motors which are designed to be run by alternating currents, Mr. Tesla has found it desirable, and even necessary, to give due consideration to this phenomenon and to make special provisions in order to obviate its consequences.

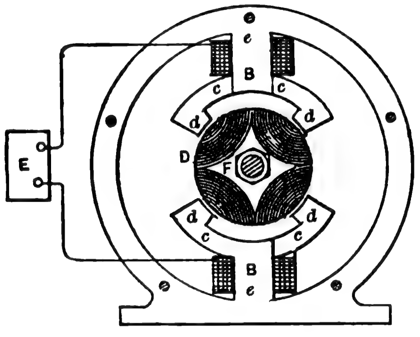


Fig. 2.—Tesla Alternating Motor.

On the other hand, by taking advantage of this very action or effect, and, by rendering it more pronounced, Mr. Tesla utilizes it in the operation of motors in general. This he effects by constructing a field in which the parts of the core that exhibit at different intervals of time the magnetic effect imparted to them by alternating currents in an energizing coil are so placed with relation to a rotating armature as to exert thereon their attractive effect successively in the order of their magnetization. By this means there is secured a result similar to that which Mr. Tesla has heretofore attained in the previous types of his motor, in which, by means of one or more alternating currents, he produces a rotation or progression of the magnetic poles or points of maximum attraction of the field of force.

The general principle involved in the action above mentioned is illustrated in the simple motor shown in Fig. 1. Here X represents a large iron core composed of a number of sheets or laminæ of soft iron or steel. Surrounding this core is a coil, Y, which is connected with a source, E, of rapidly varying currents.

Let us consider now the magnetic conditions existing in this core at any point, as b, at or near the centre, and any other point, as a, nearer the surface. According to Mr. Tesla, when a current impulse is started in the magnetizing coil, Y, the section, at a, being close to the coil, is immediately energized, while the section, at b, which, to use a convenient expression, is "protected" by the intervening sections or layers between a and b, does not at once exhibit its magnetism. However, as the magnetization of a increases, b becomes also affected, reaching finally its maximum strength some time later than a.

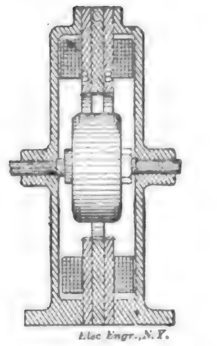


Fig. 3.—Tesla Alternating Motor.

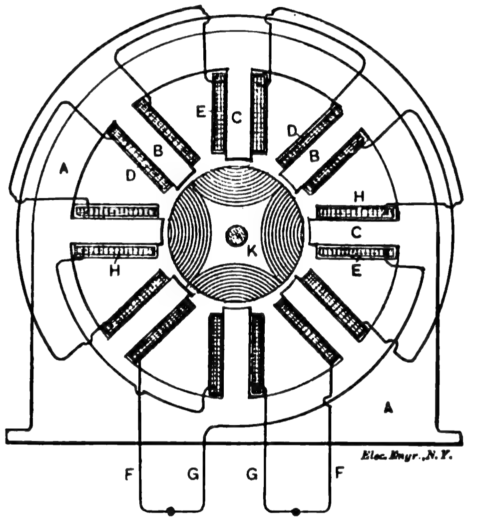


Fig. 4.—Tesla Alternating Motor.

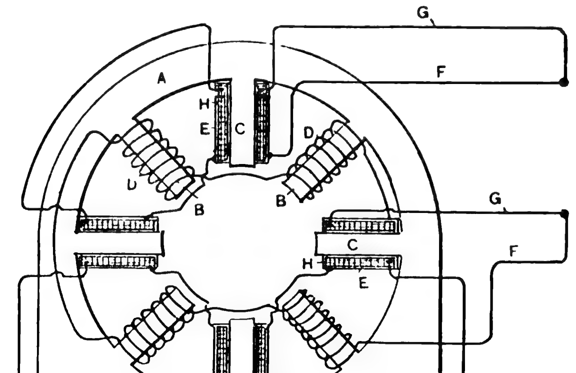


Fig. 5.—Tesla Alternating Motor.

Upon the weakening of the current the magnetization of a first diminishes, while b still exhibits its maximum strength, but the continued weakening of a is attended by a subsequent weakening of b. Assuming the current to be an alternating one, a will now be reversed while b still continues of the polarity first imparted. This action contin-

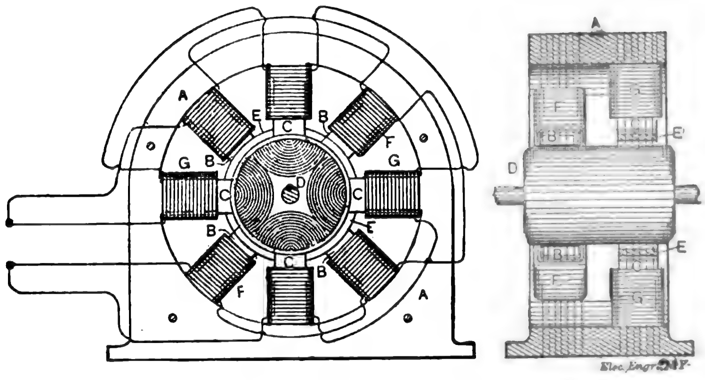
ues, the magnetic condition of b following that of a in the manner above described.

If an armature, for instance, a simple disk mounted to rotate freely on an axis, be brought into proximity to the core, a movement of rotation will be imparted to the disk, the direction depending upon its position relatively to the core, the tendency being to turn the position of the disk nearest to the core from a to b, as indicated in Fig. 1.

This action or principle of operation has been embodied in a practicable form of motor, which is illustrated in Fig. 2. Here A represents a circular frame of iron, from diametrically opposite points of the interior of which the cores project.

Each core is composed of three main parts B, B and C, and they are similarly made with a straight portion *e*, around which the energizing coil is wound, a curved arm or extension *c* and an inwardly projecting pole *d*.

Each core is made of two parts B B, with their polar extensions reaching in one direction and a part C between the other two and with its polar extension reaching in the opposite direction. These cores are wound with coils D, which are connected in the same circuit either in parallel or series and supplied with an alternating current by a generator E represented diagramatically. Between the cores or their polar extensions is mounted an armature F wound with magnetizing coils G that are closed upon them-



FIGS. 6 AND 7.—TESLA ALTERNATING MOTOR.

selves, similar to those in the older types of Mr. Tesla's motors.

The operation of the motor is as follows: When a current impulse or alternation is sent through the coils D, the sections B B of the cores being on the surface, and in close proximity to the coils, are immediately energized. The sections C, on the other hand, are protected from the magnetizing influence of the coil by the interposed layers of iron B B.

As the magnetism of B B increases, however, the sections C are also energized, but they do not attain their maximum strength until acertain time subsequent to the exhibition by the sections B B of their maximum.

Upon the weakening of the current the magnetic strength of B B first diminishes while the sections C have still their maximum strength; but as B B continue to weaken, the interior sections are similarly weakened.

B B may then begin to exhibit an opposite polarity, which is followed later by a similar change on C, and this action continues.

B B and C may, therefore, be considered as separate field magnets, being extended so as to act on the armature in the most efficient positions, and the effect is similar to that in Mr. Tesla's other forms of motor, viz., a rotation or progression of the maximum points of the field of force. Any armature, such, for instance, as a disc mounted in this field, would rotate from the pole first, to exhibit its magnetism to that which exhibits it later.

In following out the ideas stated above, Mr. Tesla has applied them to a class of motors in which two or more sets of energizing magnets are employed and in which by artificial means a certain interval of time is made to elapse between the respective maximum or minimum periods of their magnetic attraction or effect. This has already been applied to the operation of Mr. Tesla's three-wire motors. In the present instance Mr. Tesla employs a motor with two sets of energizing or field magnets, each wound with coils connected with a source of alternating currents, but forming two separate paths or circuits. The magnets of one set are protected to a certain extent from the energizing action of the current by means of a magnetic shield or screen of laminated iron interposed between the magnet and its energizing coil.

The shield is properly adapted to the conditions of particular cases so as to shield or protect the main core from magnetization until it has become itself saturated and no longer capable of containing all the lines of force produced by the current. By this means it will be seen that the energizing action begins in the protected set of magnets, a certain arbitrarily determined period of time later than in the other, and that by this means a practically economical difference of magnetic phase may readily be secured.

The nature and operation of this motor will be readily understood by reference to the accompanying illustration.

The engraving, Fig. 4, shows the simplest form of this type of machine. The cores B form one set of magnets and are energized by coils D, while the cores C, forming the other set, are energized by coils E, and the coils are connected in series with one another, in two derived or branched circuits F G respectively.

Each coil E, it will be noted, is surrounded by a magnetic shield H, which is composed of an annealed insulated or oxidized iron wire wound on the coils in the manner indicated, so as to form a closed magnetic circuit around the coils and between the same and the magnetic cores C.

Between the pole pieces or cores B C is mounted the armature of the closed-circuit coil type.

The operation resulting from this arrangement is as follows: If a current impulse be directed through the two circuits of the motor, it will quickly energize the cores B, but not so the cores C, for the reason that in passing through the coils E there is encountered the influence of the closed magnetic circuits formed by the shields H. The first effect is to effectively retard the current impulse in circuit G, while at the same time the proportion of current which does pass does not magnetize the cores C, which are shielded or screened by the shields H.

As the increasing electromotive force then urges more current through the coils E, the iron wire H becomes magnetically saturated and incapable of carrying all the lines of force, and hence ceases to protect the cores C, which become magnetized, developing their maximum effect after an interval of time subsequent to the similar manifestation of strength in the other set of magnets, the extent of which may be arbitrarily determined by the thickness of the shield H, and other well known conditions.

From the above it will be seen that the apparatus or device acts in two ways. First, by retarding the current, and second by retarding the magnetization of one set of cores, from which its effectiveness will readily be seen.

Many modifications of the principle here embodied have been made by Mr. Tesla, one only more of which we may notice here. This is illustrated in Fig. 5, and is similar in all respects to that above described, except that the iron wire H, which is wrapped around the coils E, is in this case connected in series with the coils D. The iron wire coils are connected and wound so as to have little or no self-induction, and, being added to the resistance of the circuit F, the action of the current in that circuit will be accellerated while in the other circuit G it will be retarded.

Still another type of motor constructed by Mr. Tesla is one with a field magnet having two sets of poles or inwardly projecting cores and placed side by side so as practically to form two fields of force, and alternately ar-

ranged, that is to say, with the poles of one set or field opposite the spaces between the other. The free ends of one set of poles are then connected by means of laminated iron bands or bridge pieces of considerably smaller cross-section than the cores themselves, so that the cores all form parts of complete magnetic circuits.

When the coils on each set of magnets are connected in multiple circuits from an alternating machine electromotive forces are set up in each circuit simultaneously, but the coils on the magnetically bridged or shunted cores will have, by reason of the closed magnetic circuits, a high self-induction which retards the current, permitting at the beginning of each impulse but little current to pass. On the other hand, no such opposition being encountered in the other set of coils, the current passes freely through them, magnetizing the poles on which they are wound.

As soon, however, as the laminated bridges become saturated and incapable of carrying all the lines of force, which the rising electromotive force, and consequently *increased* current, produce, free poles are developed at the ends of the cores, which, acting in conjunction with the others, produce rotation of the armature.

The construction by which this is accomplished is shown in the accompanying engravings, Figs. 6 and 7.

The frame of the motor A, is built up of sheets of iron punched out to the desired shape and bolted together with insulation between the sheets. When complete the frame makes a field magnet with inwardly projecting pole pieces B and C. To adapt them to the requirements of this particular case, these pole pieces are out of line with one another, those marked B surrounding one end of the armature, and the others C the opposite end, and they are arranged alternately; that is to say, the pole pieces of one are set in line with the spaces between those of the other sets.

The pole pieces C are connected or shunted by bridge pieces E.

The coils F and G are connected in series, respectively, in two circuits which are branches of a circuit from an alternating machine, and they are so wound that the circuit of coils G will have a higher self-induction than the other circuit or branch.

The function of the shunts or bridges E, is that they shall form with the cores C a closed magnetic circuit for a current up to a predetermined strength, so that when saturated by such current and unable to carry more lines of force than such a current produces, they will, to no further appreciable extent, interfere with the development by a stronger current of free magnetic poles at the ends of the cores C.

In such a motor the current is so retarded in the coils G and the manifestation of the free magnetism in the poles C is delayed beyond the periods of maximum magnetic effect in poles B. The result is that a strong torque is produced and the motor operates with approximately the power developed in a motor of this kind energized by independently generated currents differing by a full quarter phase.

TESLA'S TRANSFORMER FOR MOTOR WORK AND FOR CONSTANT CURRENT.

In the early forms of alternating motor brought out by Mr. Tesla the construction embodied a series of coils traversed by currents differing a quarter phase from one another. This has in some forms required three wires from the generator to the motor, but in order to avoid this Mr. Tesla has recently constructed a converter specially designed to be used in connection with his motor, and in which the difference of phase required is spontaneously brought about. This converter also possesses the valuable property that it operates with a constant current for all loads imposed upon the secondary.

In transformers as at present constructed it is found that the electromotive force of the secondary very nearly coincides with that of the primary, being, however, of opposite sign. At the same time the currents, both primary and secondary, lag behind their respective electromotive forces, but as this lag is practically the same in the case of each, it follows that the maximum and minimum of the primary and secondary currents will nearly coincide, but differ in sign or direction, provided the secondary be not loaded, or if it contain devices having the property of self-induction.

On the other hand, the lag of the primary behind the impressed electromotive force may be diminished by loading the secondary with a non-inductive or dead resistance, such as incandescent lamps, whereby the time interval be-

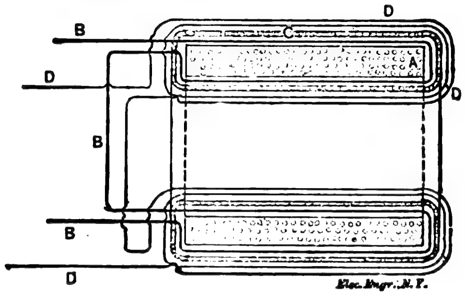


FIG. 1.—NEW TESLA CONSTANT CURRENT TRANSFORMER.

tween the maximum or the minimum periods of the primary and secondary currents is increased. This time interval, however, is limited, and the results obtained by phase difference in the operation of such devices as Mr. Tesla's alternating current motors can only be approximately realized by such means of producing or securing this difference, as above indicated. For it is desirable in such cases that there should exist between the primary and secondary currents, a difference of phase of 90 degrees, or in other words, the current in one circuit should be maximum when that in the other circuit is minimum.

To more nearly and perfectly attain to this condition Mr. Tesla secures an increased retardation of the secondary

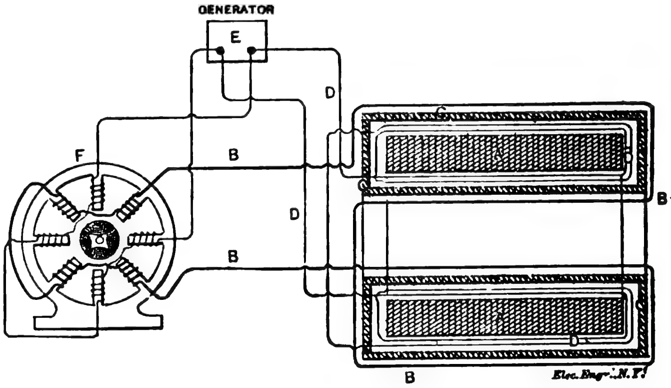


FIG. 2.—NEW TESLA CONSTANT CURRENT TRANSFORMER.

current in the following manner: Instead of bringing the primary and secondary coils or circuits of a transformer into the closest possible relations, as has hitherto been done, he protects in a measure the secondary from the inductive effect of the primary by surrounding either the primary or the secondary with a comparatively thin magnetic shield or screen.

Under these conditions, as long as the primary current has a small value the shield protects the secondary, but as soon as the primary current has reached a certain strength, which is arbitrarily determined, the protecting magnetic shield becomes saturated and the inductive action upon the secondary begins. It results, therefore, that the secondary current begins to flow at a certain fraction of a period later than it would without the interposed shield, and since this retardation may be obtained without necessarily re-

tarding the primary current also, an additional lag is secured and the time interval between the maximum or minimum periods of the primary and secondary currents is increased.

Mr. Tesla has also discovered that such a transformer, may, by properly proportioning its elements, be made to yield a constant current at all loads.

In the accompanying illustrations, Fig. 1 is a cross-section of a transformer embodying the above idea.

A A is the main core of the transformer composed of a ring of annealed iron wire. Upon this core is wound the secondary circuit B B. This latter is then covered with a layer of annealed iron wires C C, wound in a direction at right angles to the secondary coil. Over the whole is then wound the primary coil D D.

From the nature of this construction it will be obvious that as long as the shield formed by the wires C is below magnetic saturation, the secondary coil or circuit is effectually protected or shielded from the inductive influence of the primary.

When the strength of the primary reaches a certain value, the shield C, becoming saturated, ceases to protect the secondary from inductive action and current is in consequence developed therein. For similar reasons, when the primary current weakens, the weakening of the secondary is retarded to the same extent.

In the engraving, Fig. 2, the core A is built up of insulated iron plates or disks. The primary circuit D is wound next to core A. Over this is applied the shield C, which in this case is made up of thin plates of iron properly insulated and surrounding the primary, forming a closed magnetic circuit. The secondary B is wound over the shield C.

In Fig. 2, the primary of the transformer is connected with the circuit of the generator. F is a two-circuit alternating current motor, one of the circuits being connected with the main circuit from the source E, the other being supplied with currents from the secondary of the transformer.

M. ABDANK ON AMERICAN ELECTRIC RAILWAYS.

At the last meeting of Société Internationale des Electriciens, held in Paris, M. B. Abdank-Abakanowicz delivered a lecture on Electric Railways in America in which he dealt at length with details of the various systems employed in this country at the present time. M. Abdank's lecture was illustrated by means of a large number of lantern slides of American roads, and his discourse was voted a great success. With American electric railway work thus prominently brought out in France, it ought to be followed up by actual demonstration, and we believe that much could be done by our railway builders in the introduction of their work in France.

BIMETALLIC WIRES.

The Société Fonderies, Laminoirs et Tréfileries of Joinville le-Pont, says the *Bulletin Internationale de l'Electricité*, is now manufacturing bimetallic wires for telegraph, telephone, or other purposes, of which tests, made by the French Post Office authorities, show the following results :

	Number of coils tested.			
	1.	2.	3.	4.
Diameter........	1.97 mm.	1.88mm.	1.89mm.	1.95mm.
Breaking stress..	493lb.	493lb.	449lb.	603lb.
Lengthening.....	16.17 mm.	26.23mm.	19.20mm.	19.21mm.
Weight..........	57.2lb.	55.7lb.	55.2lb.	55lb.
Resistance per kilometre in ohms at Odeg. cent..	8.66	9.69	8.98	9.52

It appears that a bimetallic wire of 19/10 has the same conductivity as a copper wire of 15/10, and the same breaking stress as a copper wire of 25/10.

A NEW SWITCH FOR OVERHEAD ELECTRIC RAILWAY WORK.

We illustrate on this page a new overhead switch for electric railway service of a very simple and practical design. The accompanying illustrations will explain its workings. Fig. 3 is a view of the plan of the switch ; A B and C B represent the two tracks. In Fig. 1 the car is traveling along the track A B. When the trolley wheel

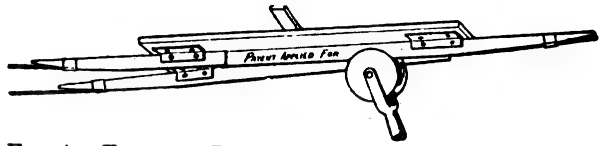


Fig. 1.—Electric Railway Overhead Wire Switch.

reaches the point E, it opens a space wide enough to allow the trolley wheel to pass. After the wheel has passed, the fin springs back into its original position. When the car is traveling on track B C, as shown in Fig. 2, the fin E D is passed over to E C, allowing the trolley wheel to pass along the track B C.

Practical experience has demonstrated the impossibility

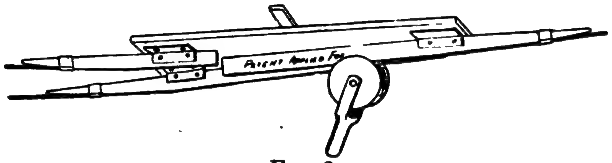


Fig. 2.

for the trolley wheel to jump the track, no matter at what speed the car may be running. The base on which the fins are placed is galvanized sheet iron, and the fins, or more properly the switches, are made of the best saw blade steel.

The trolley wires are fastened by clamps to the ends of

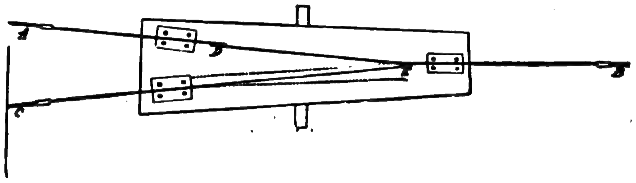


Fig. 3.

the switches, and do not necessitate soldering. The whole is supported by guy wires fastened to lugs extending at right angles to the switch, as shown in Fig. 3. This new device is being introduced by the Illinois Electric Material Co., of Chicago.

STREET NAMES READ AT NIGHT.

It is said that the inspector of streets of St. Louis has adopted a novel method of marking the names of streets, so that the darkest night will not render the way difficult to find. The names of the streets are painted upon the electric light globes and the shadow resulting throws the name upon the ground so plainly that it can be read fifty feet away. The letters on the globe are three-quarters of an inch, and the shadow is five feet wide. An arrangement of this nature would be a welcome one elsewhere.

PHONOGRAMS AND THE CUSTOMS.

Among the decisions in customs cases rendered by the Treasury Department since July 1, copies of which have just been sent by Secretary Windom to all the collectors, is one rendered July 9 affecting the phonograph. It says :

"Phonograph cylinders, imported by mail and which bear upon their surface the impressions made by the stylus of the phonograph when recording letters and messages, are considered as occupying the same position in the transportation of correspondence as the paper sheets upon which communications have heretofore been inscribed or typewritten, and should be treated in the same manner as ordinary mail matter, and subjected to no further inspection by custom officials than may be necessary to protect the interests of the revenue."

THE CHAMBERLAIN BATTERY RACK.

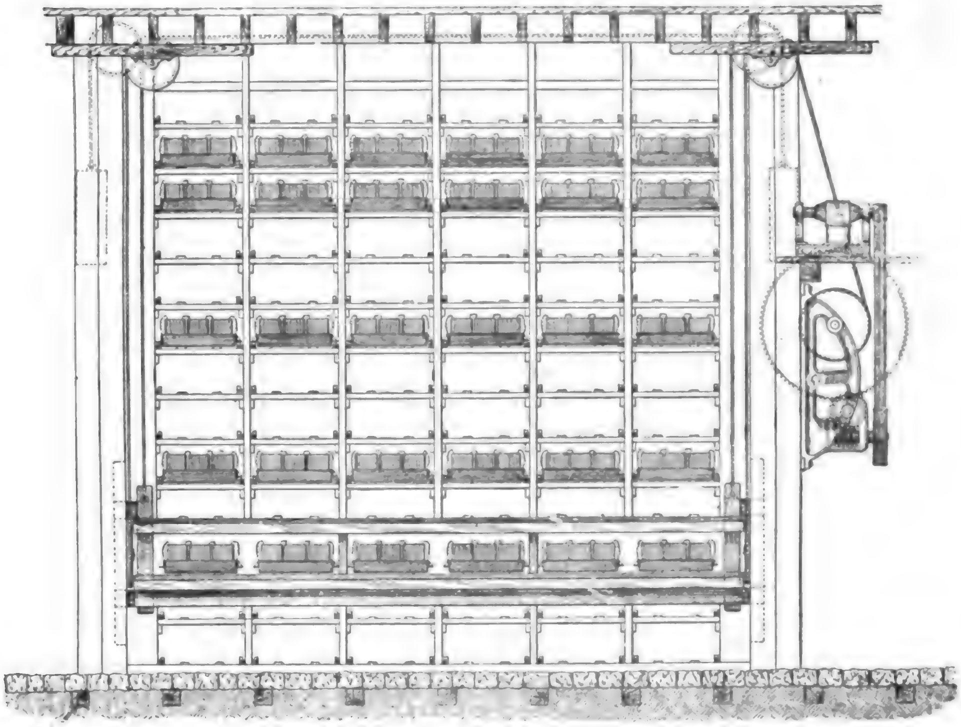
CONSIDERABLE interest has been excited by the perfection which has been attained in the operation of substituting charged for discharged secondary batteries employed in the installation of the United Electric Traction Company at their station, 85th street and Madison avenue, in this city. This work has been brought to its present complete form by Mr. J. C. Chamberlain, and embodies a number of novel and interesting features.

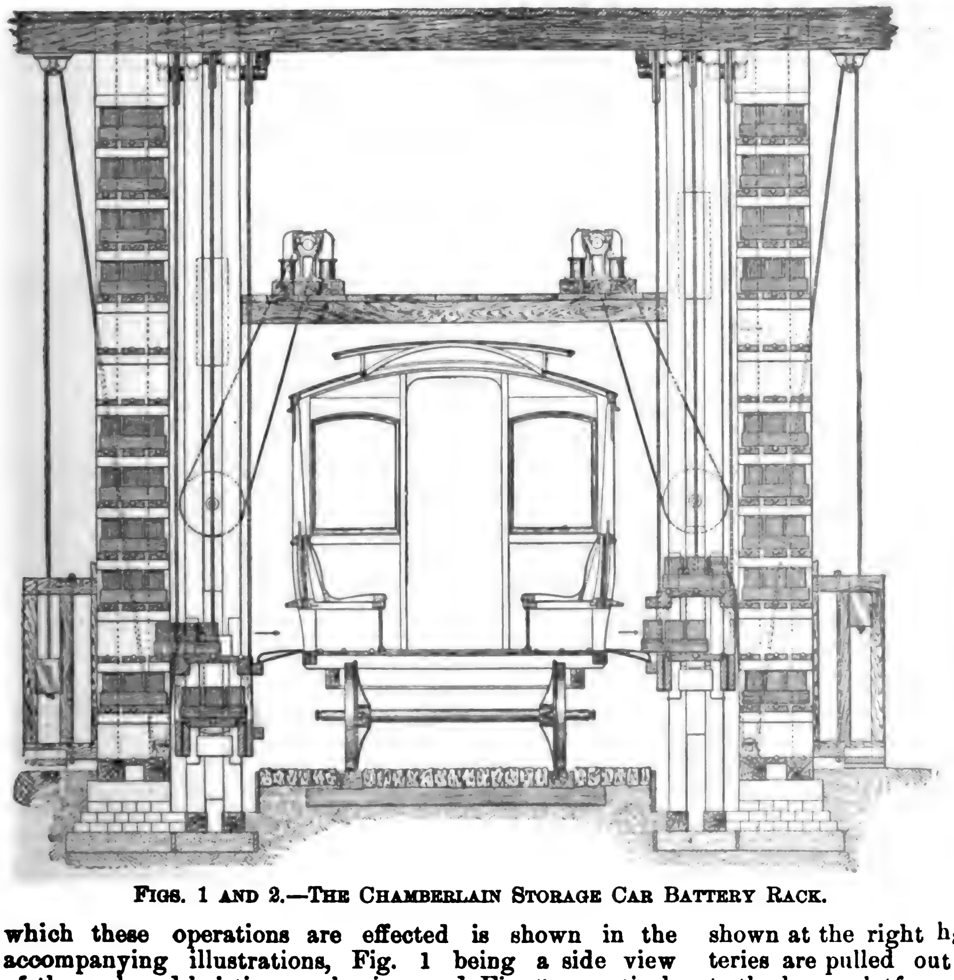
The visitor at the station is impressed with the rapidity and ease of the operation of shifting the batteries. A car having discharged batteries is run into the station, and into a sort of stall between two racks of superimposed shelves; there is a sort of sliding noise, a movement of the elevator platforms on each side of the car, and the car is rapidly run out, leaving the station within three minutes of its entry. In that time a complete set of batteries, having a charge sufficient to carry the car on its journey, to the Post Office and return (11 miles), has been substituted for the exhausted batteries, and the latter have been automatically connected into the charging circuit on the racks, and are again being charged.

The general construction of the racks and hoisting mechanism by which these operations are effected is shown in the accompanying illustrations, Fig. 1 being a side view of the rack and hoisting mechanism, and Fig. 2, a vertical, transverse section, with the car shown in position. The racks have a number of shelves superimposed, as shown, and adapted to receive the drawers of batteries. When the batteries are in place on the shelves they automatically make connections with the charging dynamos, which are not shown in these illustrations. A large number of cells may be packed within the limited floor-room taken up by these racks; the latter are placed far enough apart to receive between them a street car and usually also the hoists. The floor space occupied is but 7 by 24 feet on each side of the car, and there are contained within this space cells enough to do the work of from 130 to 150 horses. It may be fairly said that the stall room these horses would require would be about 6,000 square feet.

A pair of hoists are arranged between the racks and the car, and the hoists on the opposite sides of the car are independently operated by another pair of electric motors shown; the latter motors, however, are only used in elevating the platforms. For lowering them to any place desired, opposite the racks or the car, an ingenious friction brake in the elevator winch is used. By throwing off the motors, and allowing the hoists to drop under the control of the friction brakes, a considerable saving of time is effected.

A charged set of batteries is loaded on the upper platforms of the hoists, in readiness for an in-coming car. When the car is run into the stall, its cove panels are quickly dropped to form a bridge to the lower platform of each hoist, which has been brought into position, as shown at the right hand of Fig. 2. The discharged batteries are pulled out from the car, over this bridge, on to the lower platform, the hoist then dropped to the position





FIGS. 1 AND 2.—THE CHAMBERLAIN STORAGE CAR BATTERY RACK.

shown at the left hand in Fig. 2, and the charged batteries are shoved into place on the car; the panels are then closed up automatically, and the car moves out. The hoists are then raised, the discharged batteries on the lower shelves are run into vacant shelves at the same height on the two racks, and the top platform is re-loaded with charged batteries for the next car.

The shifting can be done rapidly by means of one man on each side; each stands on the platforms on either side, which are connected by rope with the hoists so as to rise and fall with the latter, and so as to be always in position opposite the hoist at whatever part of the rack it may be.

The system has been patented by Mr. Chamberlain in the United States and foreign countries, and the details of the construction have been well worked out. One of the most important of these is the form of binder also patented by Mr. Chamberlain and shown in Fig. 3, which is used for connecting adjacent ends of the two cells of the batteries. It is important that single cells shall be coupled rapidly and removed without disturbing the remaining cells in the same drawer; and also that good electrical contact shall be maintained between the electrode terminals, which are

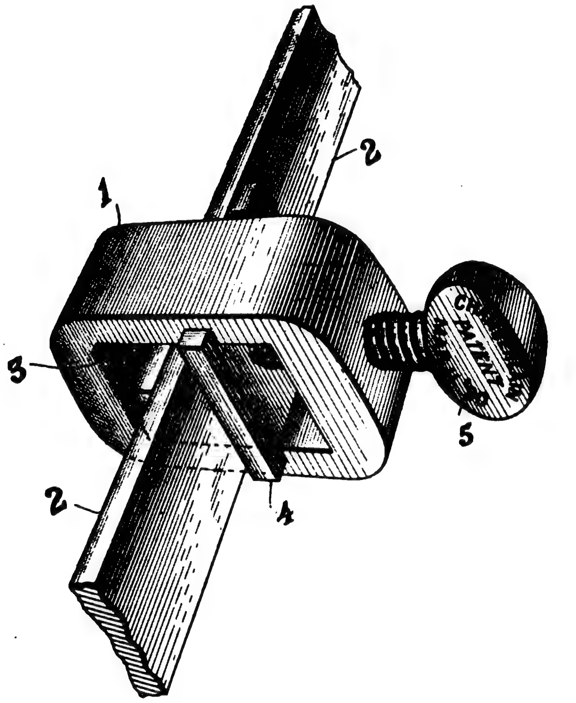


FIG 3.—CHAMBERLAIN'S STORAGE BATTERY CONNECTOR.

connected by the binder. Mr. R. N. Chamberlain is to be credited in part with the solving of this problem. Advantage is taken of the binding action of a hard rubber screw, in a socket of the same material. Referring to Fig. 3, 1 is a loop of hard rubber, which receives the two ends of the electrodes of adjacent batteries, which are represented at 2. A soft rubber cushion 3 is arranged at one end of the loop and a hard rubber washer 4, and hard rubber screw 5, at the other end. By turning the thumb screw the battery terminals are pressed tightly together between the hard rubber washer and soft rubber cushion. The rubber cushion insures the maintenance of such pressure as to prevent any turning of the thumb-screw, and loosening of the electric connection. The materials being entirely impervious to the action of the acid fumes, remain unattacked and constitute a durable and efficient method of connection.

A FLOTILLA OF PERAL SUBMARINE BOATS.

The Spanish Government, after repeated consultations with Lieut. Peral, has resolved to build a small flotilla of the submarine boats invented by that officer. The original intention was to purchase two. The vessels that have been ordered are larger than the Peral, capable of affording accommodations for a crew of from twenty to fifty men. The results of the trial of the Peral showed her to be far superior to the Goubet, the Gymnote, and other vessels of the kind.

CORRESPONDENCE.

CHICAGO.

Objecting to an Electric Factory—The Chicago Edison Company to Burn Hard Coal—Canceling Western Union Railway Contracts.

A NUMBER of the property owners on West Fourteenth street and Blue Island avenue are seeking to enjoin John J. Curran and the Schuyler Electric Company from operating a shop and factory at Nos. 437 and 439 West Fourteenth street. The premises which Curran owns have been leased to the Schuyler Electric Company, who, it is stated, propose to run night and day in order to meet the demand for their product.

Mr. George D. Morgan denies the report which was recently heard concerning the sale of the Morgan tract in Calumet to the Westinghouse Electric Company, and says that no such deal has been contemplated.

The Chicago Edison Company will shortly begin work making some change in their boiler furnaces in order to burn anthracite coal, and thereby abate the smoke nuisance. They burn some twenty-five tons of coal daily. They have not had much success with the employment of smoke consumers, and are satisfied that the best way to eliminate the smoke is to use hard coal.

A bill in equity has been filed in the United States Circuit Court at St. Paul against the Northern Pacific Railroad Company, Western Union Telegraph Company, and the Northwestern Telegraph Company, setting forth that the defendant corporators have failed to carry out the provisions of the acts of Congress of July 2, 1864, and April 10, 1869, in which the railroad company was granted valuable concessions from the United States in lands to the amount of twenty alternate sections through any State. One of the provisions of the act was that the railroad should erect and maintain a telegraph system. Subsequently the Northern Pacific made contracts with the Western Union Telegraph Company, and the complaint alleges that the contracts were beyond the powers of the railroad to make or the telegraph companies to receive and were induced by improper and corrupt considerations, and were against public policy and in violation of the rights of the United States under acts of Congress. The court is, therefore, asked to annul the contracts. The complaint is signed by Attorney-General Miller. The telegraph franchises in question extend over 2,189 miles of railway. The proceeding also denies the right of the Western Union Telegraph Company to succeed to the rights and franchises of the Northwestern Telegraph Company of Kenosha, Wis., the United States Telegraph Company, the Atlantic and Pacific Telegraph Company, the Independent Telegraph Company, the Pacific Telegraph Company, the Overland Telegraph Company, and a number of others the names of which are not specified. The complaint alleges that the Northern Pacific had no right to enter into the contracts with telegraph companies, that it was a breach of public trust and a violation of the Northern Pacific charter rights. The contracts are all declared unlawful because the Northern Pacific Railroad Company is not by and through its own corporate officers and employees maintaining and operating for railroad, commercial, and other purposes telegraph lines, but on the contrary is in all ways disregarding the provisions of the act of Aug. 7, 1888, requiring it to operate its own lines.

CHICAGO, Aug 1, 1890.

BOSTON.

Progress of the New Building of the Edison Illuminating Company—Electric Equipment of the Forthcoming Mechanics' Fair—Damage from the Electric Storm—Less Light in Electric Cars—Richards Electric Company—Proposed Appointment of an Inspector of Electric Wires for City of Boston.

THE addition to the building of the Edison Illuminating Company, of Boston, is rapidly approaching completion, and the brick work of the three new stories is now finished, and work is being done on the flooring. When completed the first floor will be entirely devoted to engines, the second floor to dynamos, the third will be used as a meter room and machine shop, and the fourth as a stock room, while the offices of the company will occupy the fifth floor, which will be tiled throughout. The increase in the underground plant during this spring and summer has been very large, some 20 miles of tubes having been laid down. The back bay district, the South End and the city are now thoroughly covered, and a map of Boston, with the feeders and mains shown therein, represents a perfect gridiron of tubes. The Edison Company are paying great attention to motor business, and every month there is an increase of about fifty horse-power.

The managers of the Mechanics' Fair, to be held in Boston in October and November, will be enabled to make a better arrangement of exhibits than has been possible in previous exhibitions. Heretofore it has been necessary to place all machinery which was to be shown in operation, near the shafting, but the Thomson-Houston Electric Co. is now to place electric motors in any part of the building where power is desired, and this will enable the

managers to give some machines better locations than could be assigned under previous conditions.

Westinghouse, Church, Kerr & Co. have been granted a large amount of floor space, and they will make an important exhibit of engines, stokers and steam supplies.

This week's thunder storm tested the West End Street Railway Company pretty severely, and kept things pretty lively for a time in the various stations. The only serious trouble, however, was the burning out of one armature, but this did not stop the traffic for more than a few minutes, as other machines were immediately cut into circuit.

The Boston *Globe* suggests this week the advisability of having less light in the electric cars which make suburban trips, during the summer, stating that those who ride in the cars would much prefer to sit "in the gloaming" and view the surrounding scenery which is obscured by such a flood of light in the car itself. The suggestion doubtless has its merits, as it is easily observable that there are large numbers of riders in the cars during the warm summer weather, of both sexes, who, apparently, would not object if there were no light at all. In certain conditions, even the electric light has its drawbacks.

The Richards Electric Company is a new concern, organized under the laws of Maine, with a nominal capital of $100,000 $10 shares, $1,000,000, and having an office at No. 3 State street. The company is based upon an improvement in telegraphy invented by Mr. Walter S. Richards of Natick. The inventions are directed toward increasing the efficiency of the telegraphic and fire alarm service through a diminished cost of battery power. It is claimed that 10 cells with the Richards appliance will accomplish the same results as 100 cells as ordinarily applied, and that it saves 90 per cent. of electromotive force. The system has been tested over Western Union wires, between Boston and New York and intermediate points, 25 cells giving the same power as 250 by the old method, and over long distance telephone wires to New York. Boston capitalists have purchased the patents, and propose to develop a commercial business. Among the interested parties are Messrs. Irving A. Evans & Co., Moore & Schley, Bayard Thayer, Albert A. Pope, N. S. Simpkins, Louis Ross, J. Otis Wetherbee, George B. James and John Simpkins, mostly Boston parties. The principle of the device, I understand, depends upon the use of an induction coil in the primary circuit, the line being connected with the secondary coil. An ingenious device is used to prevent both the "makes" and the "breaks" going to line.

Mayor Hart has sent a communication to the aldermen calling attention to the great danger from electric wires, and urging the necessity of the immediate appointment of a supervisor. In calling attention to this matter the mayor says: "A dynamo is as dangerous as a steam engine, and the wires carry this danger all over the city and into our very homes." It is proposed to appoint a wire superintendent at $4,000 a year, his term to run for 3 years.

BOSTON, Aug. 2, 1890.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.
Anonymous communications cannot be noticed.
The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.
In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.
Sketches and drawings for illustrations should be on separate pieces of paper.
All communications should be addressed EDITOR OF THE ELECTRICAL ENGINEER, *150 Broadway, New York city.*

EFFICIENCY OF THE TRANSFORMER.

[131.]—In common, no doubt, with most engineers on this side of the water, I have read Messrs. Humphrey and Powell's paper on the above subject, reported by you, and have been surprised at the results obtained. The loss by hysteresis comes out astonishingly small. There is one point, however, in the report of the paper which is not clear; and that is the method of measuring the instantaneous values of the primary currents. The instantaneous electromotive force on two lamps in the primary circuit was taken and divided by the resistance of the lamps, the lamps having been previously tested throughout their range, so that a resistance corresponded to each electromotive force on them. There is nothing in the paper to say whether the resistances taken in determining the instantaneous currents were those corresponding to the instantaneous electromotive forces, or to the effective electromotive forces. On looking up Prof. Ryan's classical paper, I find the same uncertainty.

I hardly like to suggest that Prof. Ryan and Mr. Merritt, or Messrs. Humphrey and Powell have made a slip here; but there does seem to be room for an error that would bring out the efficiency too high, especially at light loads when the lamps in the primary would be dull. The resulting determination of the power lost would be chiefly affected by the part of the current curve under the peak of the electromotive force curve, which, assuming the slip to have been made, would be too low. The top of the magnetizing current would come too high, but this would not correct the error, as there is no electromotive force then. I do not see how this possible error could give rise to greater inaccuracy in one paper than the other; even Prof. Ryan's tests of hysteresis losses are small. The hysteresis also varies with the load, which is curious.

Prof. Ryan suggests that at full load the force on the coil shakes the iron. The force should not exist in a transformer, and depends on what Prof. Ryan calls the leakage and not on the total induction through both coils Moreover, if the application of external energy, as in shaking iron, prevents loss from hysteresis appearing in the circuit, it is probable that the energy is lost as before, but is now supplied mechanically. But in the transformer the mechanical energy is itself supplied electrically, and so the loss by hysteresis would not be lessened by the shaking due to forces acting on the coils.

Some of the results in Messrs. Humphrey and Powell's paper look inaccurate. In plate i. the primary current reaches its maximum before the electromotive force is zero. This may be due to excessive Foucault currents. With no Foucault currents, the maximum primary current on open circuit necessarily corresponds with the zero of the electromotive force curve. It is here about .075 ampere. The open circuit current reaches a maximum of .11 ampere under about 800 volts. With Foucault currents eliminated it must there be less than .075, say, .07 ampere. This gives .04 ampere for Foucault currents under 800 volts, and, as the Foucault current curve must be similar to the primary electromotive force curve, with sometimes a very minute lag, due to the primary "leakage," the true magnetizing current can be traced by subtraction. It does not correspond with curve iii. of plate xiii. The Foucault current curve iv. of plate xiii. is impossible; it is leading with reference to the primary electromotive force, that is to say, at some instants the Foucault currents are supplying power to the dynamo. The same phenomenon appears in plate xiv., if I understand it properly.

I mention these points merely for elucidation; American colleges do practical work that puts ours to shame, so it would be unbecoming to attempt to criticise it from this side of the Atlantic.

JAS. SWINBURNE.

WIMBLEDON, LONDON, July 16, 1890.

ELECTRICITY NOT ALWAYS TO BLAME.

[132.]—As usual the cry has gone out that the fire in the Western Union Building was caused by an electric current. It would be most likely a difficult task to prove conclusively that it was not. It would be equally difficult to prove that it was not caused by a lighted match, cigar or cigarette carelessly thrown into some inflammable substance. The chances of the fire having been caused in the latter way are fully as great, if not greater than, in the former; but, of course, the electric current gets the benefit of the doubt.

I remember when I was connected with the Baltimore and Ohio Telegraph Company, I one time discovered an incipient fire among the wires in the battery room of one of the offices. The fire was put out before damage to any extent had been done. The origin of the fire was a lighted tallow dip used by the battery man in the dark recesses of the battery shelves, which had been carelessly placed under some of the insulated wires. Had a conflagration ensued there is no doubt it would have been attributed to the "electric current."

An acquaintance of mine recently informed me that he once thoughtlessly threw a lighted cigar into a waste paper basket. Shortly thereafter he had occasion to leave his office for a few minutes, and upon his return he found the flooring and wainscoting of the office ablaze. The fire was gotten under control before very much damage was done, and as it happened that electric light wires were embedded in the wainscoting near the flooring, at the point of the origin of the fire, the firemen concluded that the "electric current" had been at work.

No doubt in many other instances fires are quite as erroneously attributed to the action of the electric current.

WM. MAVER, JR.

NEW YORK CITY, August 1, 1890.

UNDERGROUND TELEPHONE SYSTEM AT BERLIN.

An extensive underground telephone system is now in course of construction at Berlin, and a large number of cast-iron pipes are being laid by the telegraph department for the purpose. The pipes, which are upwards of 25 miles in length, are to carry from 20 to 90 cables, and vary in diameter from 8 to 16 inches. The cables will be sheathed with iron wires, and contain uniformly throughout 28 conductors of No. 19 copper wire, insulated with impregnated fibre, and (to prevent induction or cross talk) lapped with tin foil. The cables now to be laid are over 90 miles in length, and have 2,520 miles of conductors. The cables are supplied by Messrs. Felten and Guilleaume. Man-holes (405 in number) will be placed at certain intervals for the purpose of facilitating drawing in of the cables and testing conductors. This extensive system, it is estimated, will cost about $500,000. It is hoped that when completed it will suffice for the ever-increasing number of subscribers, who already amount to 15,000.

REPORTS OF COMPANIES.

TROPICAL AMERICAN TELEPHONE CO.

The Tropical American Telephone Co. held its annual meeting at Long Branch, on July 30, when the following directors were chosen:—Chas. Williams, Jr., Col. H. S. Russell, Dr. E. P. Bradbury, J. H. Howard, and Frank W. Harrington. The report of the general manager showed business 50 per cent. in excess of the year before. Stockholders recommended the resumption of dividends and an extra. The question of amount of dividend to be paid will be decided upon at the next directors' meeting.

THE NEW YORK STOCK QUOTATION CO.

The announcement made on the Stock Exchange with regard to the Exchange's acquisition of a controlling interest in the New York Stock Quotation Company reads as follows:—

The New York Quotation Company having been acquired by the New York Stock Exchange is now prepared to furnish its members with prompt and reliable service. The following officers have been elected:—R. H. Thomas, president; A. B. Chandler, vice-president and general manager; George W. Caspar, secretary; P. W. Harding, treasurer. The directors are R. H. Thomas, P. W. Harding, A. B. Chandler, F. W. Gilley, Jr., F. H. Sturgis, W. H. Baker and William L. Bull.

All of the directors of the company except two, namely, A. B. Chandler and W. H. Baker, are Governors of the Stock Exchange. The announcement last week was simply the consummation of negotiations which have been pending for months, and is understood to be the final step in the direction of controlling the Stock Exchange quotations so as to give its own members a preferred service, and limiting their benefits to such individuals and institutions as the Exchange may see fit. Besides the New York Stock Quotation Company, the Gold and Stock Telegraph Company sends out quotations from the Exchange. Negotiations are in progress with this company by which the Exchange will control its quotations also.

STOCKS AND BONDS.

BURLINGTON, IA.—A first mortgage for the sum of $300,000 in favor of the American Loan and Trust Company and against the property of the Burlington Electric Railway Company was recorded at Burlington, Ia., last month. Bonds of $1,000 each, bearing 6 per cent. interest and running twenty years, will be issued for the above amount, the proceeds to be used in converting the old horse car lines into an electric system.

DIVIDENDS.

THE CALIFORNIA ELECTRIC LIGHT CO., of San Francisco, has declared a dividend of 20 cents per share.

NEWARK, N. J.—The Newark Electric Light and Power Co. has declared a quarterly dividend of 1¼ per cent.

FINANCIAL MARKET.

QUOTATIONS OF ELECTRICAL STOCKS.

Mr. F. Z. Maguire, of 18 Wall street, this city, reports the following quotations of August 2, on the New York, Boston and Washington Exchanges:—

NEW YORK:	Bid.	Asked.
Western Union Tel.	83⅞	
Edison Gen. El. Co.	107	
" " " deferred	96	
Consolidated El. Light	60	
Edison El. Ill. Co.	70	
United States El. Light	35	
BOSTON:		
Thomson-Houston El. Co.		53
" " " Pr'ef'd		25
" " " " Series C.		12
" " " " " D.		6½
" " International El. Co.		
" " Welding Co.		
" " European Welding Co.		91
Ft. Wayne Electric Co.	12½	
Telephone.—		
American Bell		227¼
Erie		54
New England		53¾
Mexican		80c
Tropical American		
Miscellaneous:		Asked.
Edison Phonograph Doll		8½
WASHINGTON:		
Pennsylvania Telephone		25
Chesapeake & Potomac Telephone		*76½
American Graphophone		16½
U. S. El. Light (Washington)		164
Eckington & Soldier' Home El. Ry		69

*Ex-Dividend.

METAL AND SUPPLY MARKET.

COPPER PRICES.

There was hardly any trading in copper on the Metal Exchange during the week July 28–August 2. At the close of the week margins were called at 17 cents. On Friday, August 1, the visible stock of copper on hand was estimated at 73,000 tons, substantially the same as on July 1. Following are circular prices of copper, tin and lead August, 1890, and August 2, 1889:

	August 1, 1890.	August 2, 1889.
Straits tin, spot	20.80	19.75
Straits tin, Oct	20.90	19.80
Lake copper, Aug	17.00	11.75
G. M. B. copper, Aug	—	8.75
Domestic lead, spot	4.45	3.97½
Domestic spelter, Aug	5.40	—

SOCIETY AND CLUB NOTES.

TOPICS TO BE DISCUSSED AT THE CAPE MAY MEETING.

Mr. Allen R. Foote, secretary of the National Electric Light Association, reports that the Committee on Papers have selected the following topics and have invited the persons named to prepare a paper or open a discussion on the subject assigned him:

1. *Electrical Industries and the World's Columbian Fair*, J. P. Barrett, Chicago.
2. *Electric Light as Supplied to Steam Railroads*, W. H. Markland, Altoona, Pa.
3. *Standards of Economy in the Generation of Power and Steam Under Best Conditions*, Editor of *Power and Steam*, New York, H. M. Swetland.
4. *Triple Expansion High Speed Engines for Central Station Work*, Williams, Beloit, Wis.
5. *The Model Boiler-Room and the Duties of a Fireman*, Jarvis B. Edson, New York.
6. *Ferranti Station at London, England*, Caryl Haskings, Lynn, Mass.
7. *The Proper Care and Management of Alternating Currents*, T. Carpenter Smith, Philadelphia.
8. *Distribution of Energy by Alternating Currents and Transformers and the Proper Method of Proportioning Conductors*, A. L. Rohrer, Lynn, Mass.
9. *The Proper Basis for Determining Electric Motor Rates*, H. L. Lufkin, New York.
10. *Actual Cost of Furnishing Arc Lighting (1,200 c. p. and 2,000 c. p. Lamps) Under the Best Possible Conditions*, J. C. Ayer, St. Louis.
11. *Municipal Ownership of Electric Lighting Plants*, M. J. Francisco, Rutland, Vt.
12. *Accidents in Electric Lighting Stations and Plants*, Prof. Charles R. Cross, Boston.
13. *Care and Labor in Electric Light Stations and Its Value*, A. J. DeCamp, Philadelphia.
14. *How Can the National Electric Light Association Best Serve the Interests of Central Station Companies?* C. R. Huntley, Buffalo, N. Y.

REPORTS TO BE CONSIDERED.

1. Committee on National Insurance Rules,
George Cutter, Chairman.
2. Committee on Electrical Data,
A. J. DeCamp, Chairman.
3. Committee on Copper Tariff,
Charles A. Brown, Chairman.
4. Committee on Underground Conduits and Conductors,
Joseph E. Lockwood, Chairman.
5. Committee on Revision of Constitution.
M. J. Francisco, Chairman.
6. National Committee on Legislation,
Allen R. Foote, Chairman.
7. Committee on Relations Between Manufacturing and Central Station Companies,
Marsden J. Perry, Chairman.

8. Executive Committee,
C. R. Huntley, Chairman.
9. Finance Committee,
John A. Seely, Chairman.
10. Secretary and Treasurer's Report,
Allen R. Foote.

At each session of the Convention a call will be made for the proposal of questions to be discussed at a subsequent session and for the introduction of resolutions to be considered at a subsequent session when reported by the Committee on Resolutions for action.

Members desiring to take part in the discussion of any subject stated or proposed, who send their names to the Secretary previous to the time appointed for its consideration, will be called upon by the President and be given time before the subject is opened to the Convention. By this means every member can secure recognition and time to express his views fully on any subject that may come before the Convention. It is not expected that those to read papers or open the discussions will monopolize all the time that can be given to, or exhaust, the subject. The best results from discussions can be obtained only when every member who has an idea to explain, a suggestion to offer, or a bit of experience to relate regarding any subject before the Convention, will avail himself of the regulation, stated above, to secure recognition and time that will give him an opportunity to make his contribution to the common stock of information.

An announcement of the order of proceedings will be made for each day on the preceding day. The subjects and reports will be taken up in the order there named, and will be held under consideration until finished. Each afternoon session will be prolonged until the Calendar for the day has been cleared.

The last session will be an Executive Session to be attended by active members only. The business to be brought before the session will be:—

1. Secretary and Treasurer's Report.
2. Report of Finance Committee.
3. Report of Executive Committee.
4. Action on Report of Committee on Revision of Constitution.
5. Election of Executive Committee.
6. Selection of Next Place of Meeting.

LEGAL NOTES.

PROPULSION BY STORAGE BATTERIES.

FINAL REJECTION OF FAURE'S APPLICATION FOR A PATENT ON IMPROVEMENTS IN THE APPLICATION OF SECONDARY BATTERIES AS A MOTIVE POWER.

Decision of the Supreme Court, D. C.

The application was filed May 25, 1887. No. 239,318. The invention is stated in the specification to consist—

in the application of secondary batteries or accumulators preferably carried by a vehicle, or upon one of a train of vehicles, to supply electrical energy to one or more electro-magnetic motors also carried by or upon the said vehicle, or one or more of a train of vehicles, combined with means for varying the amount of energy supplied by the battery.

The original claims were twenty-two in number, and were drawn to cover the propulsion of vehicles by means of a secondary battery of the Faure type, whether or not the battery should be mounted upon the vehicle.

After various actions by the Examiner and amendments by the applicant the claims were reduced to two, introduced by amendment January 30, 1888, viz.:

1. The combination of a moving vehicle propelled by rotary motion imparted to a shaft or axle, a secondary battery having a plate, support, or conductor, coated, combined or associated with a mechanically-applied active or absorptive substance, an electro-magnetic motor electrically connected to said battery and a mechanical connection between the shaft or axle of the vehicle and the moving part of the motor, substantially as described.

2. The combination of a wheeled vehicle propelled by mechanical motion imparted to a shaft or axle, a secondary battery carried by the said vehicle and consisting of two or more plates, supports or conductors, combined or associated with a mechanically-applied active or absorptive substance, a dynamo electric motor, electrically connected to said battery, and a mechanical connection between the shaft or axle of the vehicle and the moving part of the motor, substantially as described.

The amended application was rejected by the Primary Examiner upon reference to the French journal, *L'Electricité*, of August 5, 1880 (vol. iii., pp. 253 and 254), containing a description of a boat propelled by an electric motor supplied with current by a Reynier battery. The Reynier battery is also described in the same volume of *L'Electricité* as a battery that is regenerated after exhaustion by an electric current. The Examiner held that, it being old to propel vehicles by secondary batteries, it could not be patentable to employ a particular kind of secondary battery for that purpose.

Upon appeal the Examiners-in-chief not only affirmed the decision of the Primary Examiner, but increased its scope; holding that,

One battery of any known kind having been used in a combination substantially the combination of the claims, for the purpose of the combination, the substitution of another kind of battery in the place of the one already used;—for example, a secondary in place of a primary, or one type of secondary battery in place of another type of secondary battery,—involves simply a double use of the substituted battery and produces no new invention.

The case was then appealed to the Commissioner of Patents, whose decision of February 21, 1890, affirmed the decision of the Board of Examiners-in-Chief. The official summary of the Commissioner is as follows:—

1. INVENTION—WANT OF NOVELTY—STATE OF THE ART.

Where the prior art disclosed that it was old and well known to apply electrical energy to the propulsion of a boat by means of a battery, mounted upon the boat, capable of being regenerated, and also to propel a locomotive engine or vehicle by means of electricity supplied by a primary battery mounted thereon, and that such contrivances were successful in the sense of being operative, although they involved great expense and were not successful commercially, *Held* that no invention was exercised in applying the Faure secondary battery to the propulsion of vehicles, no adaptation being required to make it available for the specified purpose.

2. SAME—SAME.

Nothing was better known than that a source of propulsive energy for vehicles must, if mounted upon the vehicle, have great efficiency in proportion to its weight, and when the Faure battery appeared, possessing qualities which were antecedently recognized as necessary for propulsion under the conditions named, nothing was more obvious than that, to the extent to which it possessed these qualities, it was adapted for vehicle propulsion when mounted upon the vehicle.

3. PROTECTION OF INVENTIONS—PROLONGATION OF MONOPOLY.

The first inventor is entitled to all the benefits which spring from the obvious uses of his invention. Others may patent the means by which they adapt it to uses not antecedently obvious; but the inventor is entitled to a free field for the exercise of all the qualities and special adaptations that belong to his invention. So, too, the public are entitled to practice the invention in all its obvious utilities when the patent has expired and may not lawfully be debarred from the enjoyment of it by subsequent patents seeking to monopolize uses which, although special, are at the same time recognized by persons skilled in the art as pertaining to it.

4. FAURE'S INVENTION.

To the Faure secondary battery must be ascribed all the success which attends upon all the uses to which skilled mechanics have the capacity to apply it.

In the text of his decision the Commissioner says:

In the proposed application of the Faure battery no adaptation is required to make it available for the specified purpose, no change is made in the battery nor in any other of the enumerated parts of the old combinations, and the specification dwells upon the excellencies of the patented battery for the purpose described and claimed.

In the argument of counsel great stress was laid upon the fact that Faure first achieved success. The obvious reply is that his success was the success of his battery. To illustrate, if the first person who applied a steam-engine of any kind to the use of propelling a steamboat made an operative success, but had been unable to attain a commercial success on account of the great relative weight of the engine, the inventor who should remove the difficulty by inventing a steam-engine of superior power relative to weight and operating upon a new principle would achieve success through the medium of his superior engine, and not through the combination of the engine with the boat propelled. To the Faure battery must be ascribed all the success which attends upon all the uses to which skilled mechanics have the capacity to apply it. * * * To use a better battery in a combination in which an inferior one had been previously used is not to make a new combination. Of course if means of combining the old instrumentalities are called into existence in connection with the substitution of the superior for the inferior source of energy, such new means would be patentable if they involved invention. But in that case the range of patentability would not extend beyond the means employed to adjust the improved source of energy to the old combination.

Applicants finally appealed to the Supreme Court of the District of Columbia, where the case was ably and comprehensively argued by Counsel for Faure, Mr. Frederick H. Betts and Mr. W. B. Vansize.

Mr. Justice Hagner delived the opinion of the court July 7, fully sustaining the decision of the Commissioner of Patents.

INVENTORS' RECORD.

Patents issued July 29.

Conductors, Conduits and Insulators:—*Conduit for Telegraph Cables*, W. R. Patterson, 433,025. *Insulating Compound*, I. Babinowicz, 433,215. *Pole for Supporting Electric Wires*, L. Atwood, 433,266.

Dynamos and Motors:—*Dynamo Electric Machine*, H. W. Spang, 433,051. *Regulator for Dynamo-Electric Machines*, P. P. Belt, 433,269. *Brush-Holder for Electrical Machines*, W. S. Belding, 433,390. *Armature for Dynamos*, W. S. Belding, 433,391. *Blank for Armature Coil-Guards*, W. S. Belding, 433,392. *Commutator for Dynamos*, W. S. Belding, 433,393. *Magnetic Coupling Device*, T. M. Foote, 433,400. *Variable-Speed Gearing for Electric Cars*, T. M. Foote, 433,401. *Reversing Gear for Electric Cars*, T. M. Foote, 433,402. *Electric Railway*, R. M. Hunter, 433,407, 433,408 and 433,409.

Galvanic Battery:—*Galvanic Battery*, H. J. Brewer, 432,973.

Lamps and Appurtenances:—*Electric Light Fixture*, F. H. Aldrich, 432,-965. *Electrode for Arc-Lamps*, L. Saunderson, 432,041. *Holder for Incandescent Electric Lamps*, A. Schirner, 433,371.

Medical and Surgical:—*Electrical Syringe*, J. B. Woodward, 433,384.

Miscellaneous:—*Electric Cut-Out*, H. A. Chase, 432,978 and 432,979. *Fuse-Block and Lightning Arrester*, H. A. Chase, 432,980. *Automatic Electric Switch and Cut-Out*, C. R. Doyle, 432,988. *Electro-Magnetic Cut-Out*, B. J. Noyes, 433,022. *Safety Cut-Out*, C. E. Scribner, 433,045. *Loop-Key*, C. E. Scribner, 433,046. *Safety Cut-Out*, M. S. Shapleigh, 433,187. *Thermal Cut-Out*, A. Bernstein, 433,229. *Electric Switch*, J. F. McLaughlin, 433,360. *Electric Heat-Regulating System*, F. M. Sparrow, 433,375. *Electro-Magnetic Transmitter*, J. T. Williams, 433,381. *Lightning Arrester*, A. Wurtz and O. H. Baldwin, 433,430.

Railways and Apparatus:—*Electric Railway*, R. M. Hunter, 433,170. *Electric Motor Traction Wheel*, A. L. Parcelle, 433,180. *System of Electrical Transportation*, A. L. Parcelle, 433,181. *Electric Apparatus for Railways*, J. B. Odell, 433,210. *Automatic Electric Train Signal*, A. W. Peppy, 433,216. *Contact Device for Electric Railways*, F. J. Sprague, 433,425.

Secondary Batteries:—*Separator for Secondary Batteries*, 433,174, W. P. Kookogey.

Telegraphs:—*Dynamo-Telegraphy*, F. W. Jones, 433,082. *Telegraphic Circuit*, A. C. Robbins, 433,421.

Telephones and Appliances:—*Test Circuit for Multiple Switch-Boards*, C. E. Scribner, 433,047. *Telephone*, S. D. Field, 433,120. *Combination Telephone-Key*, C. E. Scribner, 433,424.

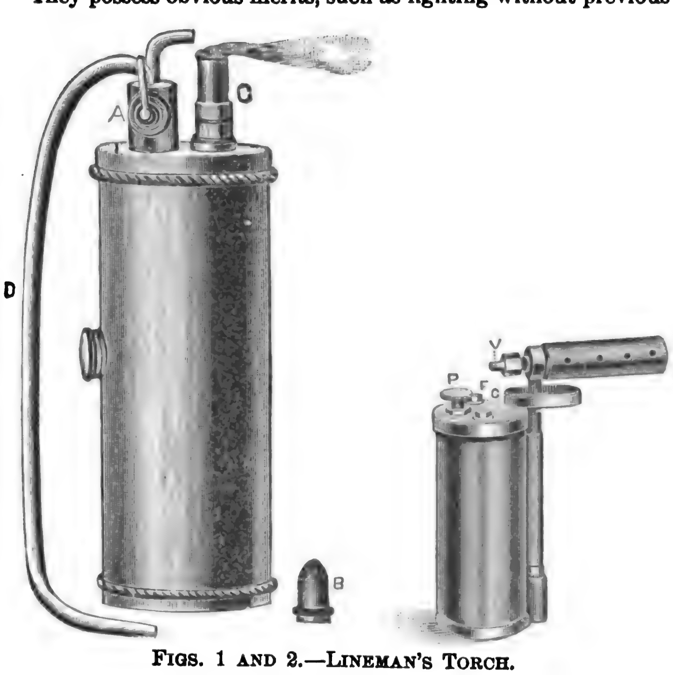
TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

LINEMEN'S TORCH EQUIPMENT.

Upon nothing so much as thorough equipment does the s ıccess of what may be called the tactics of construction depend. Designing is the strategy of electrical engineering; putting the result into operation is the tactics. The appended illustrations are of appliances which contribute in a great degree to the excellence of linemen's work. Figs. 1 and 2 are two forms of the Walsh continuous gasoline torch, made by the Walsh Manufacturing Company, of Chicago.

They possess obvious merits, such as lighting without previous



FIGS. 1 AND 2.—LINEMAN'S TORCH.

heating, fine workmanship, portability, immunity from accident and safe to the point of being turned upside down without the least danger. The heat is intense and has a wide range of regulation effected by shields attachable to the nozzle by a screw thread and quickly shifted as required. One gives a thin, lancelike flame, long or short, and the other a large brush-shaped flame for large work, with the same adjustibility of length as the smaller flame.

Its joints in lead pipe are shown, by a large number of tests, much stronger than the pipe itself, and it can be used four hours without the least intermission, without inconvenient heating. Its durability is shown by the fact that torches over two years in constant use are not yet in need of repairs.

The cost of maintenance ranges from one to four cents per day dependent upon the proportion of the work.

THOMPSON'S PATENT CHART.

Mr. E. P. Thompson, of Temple Court, Beekman street, has compiled and published a very interesting and useful chart, intended for the use of U. S. inventors, showing the fees, terms of duration, populations, terms of caveat, cost of trade marks, cost of securing patents, etc., in this country and all the countries of the world where it is desirable to obtain patent protection. Mr. Thompson has put an immense amount of work on this chart and has copyrighted it. It is a thing of great value for reference. Mr. Thompson utilizes the other side of the chart to give some interesting information about his own large patent practice.

THE NEW INSULATED WIRE OF THE AMERICAN CIRCULAR LOOM COMPANY, OF BOSTON.

Line wire is a subject at all times interesting to an electric station superintendent. When he has got his station into as perfect running condition as possible, economical boilers, economic steam engine, and efficient dynamos and lamps, he next wants to know where he can find a good line wire, one that will save the leakage of current from his lines, which means a saving of energy, and consequently a saving of dollars and cents. There are many good line wires in the market, he finds, and there are continually new ones being brought out. Among the most recent wires is that manufactured by the American Circular Loom Company of Boston, which is worthy of notice, as the insulating covering is put on in a different way from any other wire now manufactured. This woven insulated wire has attracted considerable attention of late, and the writer had the pleasure recently of making a thorough examination of the method of manufacture. The factory is situated at North Hanover. Mass., and is well equipped with plenty of water and steam power. Nearly all line wires have their insulation composed of cotton. jute or hemp, or other fibrous material, braided on the copper by the well known braiding machines, and then soaked in some insulating compound. The insulation of American Circular Loom Company's wire, however, is not braided but woven on by means of circular looms of improved type, the invention of Mr. Charles T. Stetson. The cotton is No. 12 single, and is twisted together at the factory in as many ply as is necessary for the size of wire to be covered. The twisted cotton is then put in the loom, which works exactly the same as looms for weaving flat fabrics, so many bobbins forming the woof, and so many bobbins being so shaped as to fit the shuttles which circulate round the loom and forming the warp. The looms are about four feet in diameter, and the mechanism is extremely simple and interesting to the eye of a mechanic. The shuttles move round very rapidly, the woof being moved up and down by means of eccentric rods on revolving discs, so that the warp passes below one thread and above the next one. When completed the woven insulation is very hard and firm, and has the appearance of a canvas jacket, like a piece of sail cloth around the wire. The wire is then taken to the compounding house, where a special compound is forced into the cotton insulation by a secret process, so effectually that every fibre of cotton is thoroughly impregnated. It is then polished and finished and wound on drums for shipment. When finished, the insulated wire has a peculiarly tough finish, and is particularly capable of withstanding a large amount of abrasion, and is at the same time as waterproof as any line wire with cotton fibre in the insulation can be, and is to a very extraordinary degree fire-proof. The American Circular Loom Company have their offices at 620 Atlantic avenue, Mr. H. H. Brooks being general manager, with Mr. A. T. Clark as treasurer, and the company are reported to have large orders ahead, and are working to their full capacity.

THE BREWER CONDUIT ELECTRIC RAILWAY SYSTEM.

Attractive as the conduit system of operating electric railways has proved to be, it cannot be looked upon yet in the light of a success. Had the methods in operation up to date been reliable and economical, as the situation demands, there would unquestionably have been a rapid extension of the work. But conduit railroading has lingered and languished in a quite remarkable manner. Mr. W. J. Brewer, C. E., an Englishman, and member of the London Chamber of Commerce, Engineering Section, has had his mind on the subject for some time past, and his visits to this country have impressed him with the desirability of a good practical conduit system, such as could be introduced in large cities, and compete with overhead wires in economy of installation, while doing away with the objections of which one hears so much. Mr. Brewer has submitted his system to our inspection, and we are free to confess that it strikes us as having many elements of great merit and success. One of the points aimed at has been infrequent exposure of the conduited conductors, thus ensuring higher insulation and less leakage or fear of short circuit. Another striking feature is the fact that in adopting the system an established line need not make heavy expenditures to do so, but is compelled to change only one rail of the track. Evidently the cost of construction is minimised, as well as the cost of maintenance. As soon as Mr. Brewer's patents are issued, we hope to enter upon a detailed description of his highly ingenious methods and ideas.

Mr. Brewer has also designed an ingenious frictionless bearing for the axles which not only effects ease in running but allows of ready starting of the car.

YALE & TOWNE MFG. CO.

The Yale & Towne Mfg., Co. of Stamford, Conn., have contracted for a 40 h.p. Edison dynamo, which is to supply current for 2 motor cars on 1800 feet of tramway track and for motors in various parts of their big factory. The motors are of the Sprague type.

C. & C. ELECTRIC MOTOR CO.

The output of motors during the present summer, by the C. & C. Electric Motor Co., 402 and 404 Greenwich street, this city, has been far in excess of their expectations. Until recently their announcements stated that they had 8,000 motors in operation. It now reads "over 10,000 motors in actual operation." In fact, the total of the sales of the last six weeks is equal to that of any previous entire year. Such a state of affairs must be extremely gratifying to the concern.

THE EMPIRE CITY ELECTRIC CO.

Owing to the rapid exhaustion of the last edition of their handsome catalogue, the Empire City Electric Co., of 15 Dey street, have been compelled to issue a notice to that effect, stating that they are now getting up a new and more complete one, which will be distributed as soon as ready. In the meantime they will be happy to give prices, information, etc., with regard to any part of their large stock of standard goods and specialties.

WENSTROM CONSOLIDATED DYNAMO AND MOTOR CO.

The above company, through their selling agents, Chadbourne, Hazelton & Co., 416-18-20 Walnut street, Philadelphia, have now issued an extremely tasteful and effective pamphlet relative to their systems of light and power. It is printed in tint on the best paper, and has steel plate engravings on the cardboard covers, which are tied with variegated silk cord. The pamphlet is well illustrated and contains a good description of the Wenstrom machine. A list is also given of some of the plants now in operation, and the closing pages contain the announcements of the various associated enterprises engaged in developing the system.

INTERIOR CONDUIT AND INSULATION CO.

The Interior Conduit and Insulation Co. have been obliged to enlarge their office facilities at No. 16 Broad street, by acquiring another large room on the same floor. It will be occupied this week by Mr. Edwin T. Greenfield, electrician of the company, and by draughtsmen under his instructions. The company are now waiting the delivery of ten new machines for the manufacture of interior tubing alone, and with the aid of these they hope to be ready by the first of next week, to catch up with their orders.

THOMSON-HOUSTON WORK.

The new office building of the Thomson-Houston Co., on Centre st., Lynn, will be occupied at once. A day or two ago the company assembled the largest generator for the transmission of power it has ever built. It is 250 horse-power, 8½ feet high and weighs 23 tons. It is now being tested. It is for railway work, and will go into the West End Co.'s power house in Boston. The new factory, J, for the manufacture of mining machinery, under C. J. Van Depoele's coal-cutting patents, has begun operations this week. When fully running it will have 100 men. Mr. Van Depoele is in charge for the present, and he will have as his assistant A. J. R. Fiego, an electrician who has assisted him in developing the inventions. The lines for the new oil house have been staked out.

THOMSON-HOUSTON SALES IN THE WEST.

We give below the July sales in the West of the Thomson-Houston Chicago office:—*Arc*—Highland Park Electric Co., Highland Park, Ill., 30 lights; Capital Gas Co., Sacramento, Cal., 50 lights; T-H. E. Lt. & Pr. Co., Meridian, Miss., 25 lights; Hyde Park, Ill., 50 lights; Studebaker Bros., So. Bend, Ind., 200 lights; Famous Mfg. Co., Indiana, 30 lights; C. C. Travis, Owosso, Mich., 60 lights; Oakland Gas Lt. & Heat Co., Oakland, Cal., 50 lights; Chillicothe Water & Lt. Co., Chillicothe, Mo., 70 lights.

Incandescent.—Iowa Institution for Feeble Minded Children, Glenwood, Iowa, 500 lights; Ionia Elec. Co., Ionia, Mich., 1300 lights; H. W. Michael, Leadville, Colo., 150 lights; Thomas Elec. Lt. & Pr. Co., Ottawa, Ill., 1300 lights; Chicago Arc Lt. & Pr. Co., Chicago, Ill., 1300 lights; Cleveland Elec. Lt. Co., Cleveland, O., 1300 lights; Hyde Park T-H. Lt. Co., Hyde Park, Ill., 2,600 lights; Aspen Mining & Smelting Co., Aspen, Col., 50 h. p. generator; C. C. Travis, Owosso, Mich., 650 lights; Chillicothe Water & Lt. Co., Chillicothe, Mo., 500 lights; Wm. Ritchie Co., Chicago, 200 lights.

THE EDISON-LALANDE BATTERY.

A very pretty and original pamphlet on the Edison-Lalande battery has been issued by the Edison Manufacturing Co., James F. Kelly, sales agent, 19 Dey street, setting forth the merits and claims of the Edison-Lalande battery. It comprises a large amount of information on the subject, including a number of curves and tables that bring out graphically the qualities of the battery. At the foot of many of the pages are quoted testimonials from users of the battery on all classes of work, and there is a consensus of approval as to the results its gives.

NEW YORK INSULATED WIRE CO.

The above company, of 649 and 651 Broadway, this city, have issued another edition of their excellent catalogue and price list. It is in many respects the best piece of work of its kind, being small, neat, very complete, well arranged, and giving not only copious information as to the Grimshaw wire and cables but a variety of data that one needs constantly for reference.

NEW WESTINGHOUSE PLANTS.

The Monongahela City Electric Company, an organization lately established, has just concluded negotiations with the Westinghouse Electric and Manufacturing Company for alternating current incandescent apparatus of 750 lights capacity.

The new Westinghouse alternating current arc light system is in favor at Moline, Ill., and with the Jarecki Manufacturing Co., Erie, Pa., and is being installed now to the extent of twenty-five lights in each place.

Washington, Georgia, is to be illuminated by the alternate current system of electric lighting. The Westinghouse Electric and Manufacturing Company has been awarded the contract for the installation of its apparatus for a capacity of five hundred lights.

The Westinghouse Electric and Manufacturing Company has just sold a forty-light dynamo of its alternate current arc light system to go to Three Rivers, Michigan, there to be used by the electric lighting company of the town for the nightly dispensing of brightness.

CHESTER FOUNDRY AND MACHINE CO.

The Brotherhood three-cylinder engine is built in this country by the Chester, Pa., Foundry & Machine Co., who are the sole manufacturers for the United States. The company also do a large business in boilers and wrought iron work and heavy machinery. So well are they employed, with old and new orders, they now have work on hand for two years ahead.

THE WORLD'S FAIR—MR. J. P. BARRETT'S NOMINATION WIDELY ENDORSED.

Among Eastern signatures to the petition to the Board of Directors of the World's Columbian Exposition, requesting the selection of Mr. J. P. Barrett, electrician of the city of Chicago, to have practical charge and control of the electrical department of the Exposition, are the following:—

IN NEW YORK AND VICINITY.

W. J. Holmes, supt. Western Union Tel. Co.; Geo. M. Phelps, president THE ELECTRICAL ENGINEER; D. J. Carson, sec'y So. Bell Telephone and Telegraph Co.; Samuel Insull, second vice-president, Edison General Elec. Co.; Edw. H. Johnson, prest. Interior Conduit and Ins. Co.; J. H. Bunnell & Co.; E. H. Cutler, mgr. Elektron M'f'g Co.; The Empire City Electric Co., H. G. Madden, ass't gen. mgr.; Henry D. Stanley, sec'y Bridgeport Brass Co.; C. H. Lane, electrical supplies; G. A. Hamilton, Western Electric Co., N. Y. City; Thos. Whiteside Rae, C. E.; THE ELECTRICAL ENGINEER, New York; Allen R. Foote, Washington, D. C.; Townsend Walcott, electrical engineer; Franklin L. Pope, electrical engineer; Chas. Cuttriss, elect. Commercial Cable Co., New York; Geo. G. Ward, gen. mgr. Commercial Cable Co., Mackay-Bennett; George Worthington, editor *Electrical Review*; Chas. W. Price, associate editor *Electrical Review*; Wm. Maver, electn. the Cons. Telegh. & Subway Co.; H. C. Adams, agent Fort Wayne Electric Co., 115 Broadway, New York; J. Stanford Brown, elec. engr., with United Electric Traction Co., 115 Broadway, New York; Wm. Bracken, prest. Consolidated Electric Traction Co., 120 Broadway, New York.

IN BOSTON AND VICINITY.

Pettingell Andrews Co., by F. E. Pettingell, Pres.; Bernstein Electric Co., by H. B. Cram, Treas.; Eastern Electric Cable Co., by Henry A. Clark, treas. and gen. man.; S. A. Barton of Thomson-Houston Electric Co.; Thomson-Houston International Electric Co., Geo. W. Davenport, gen. mgr.; Thomson-Houston Electric Co., C. A. Coffin treas., E. I. Garfield, secy.; T.-H. Elect. Light & Power Co., Buffalo, N. Y., George Urban, Jr. pres.; Eco Magneto Clock Co., C. A. White pres. and gen. mgr., George B Fessenden, treas.; American Circular Loom Co., H. H. Brooks. mgr.; Elihu Thomson, of Thomson-Houston & Thomson Welding Co.; A. L. Rohrer, of Thomson-Houston Electric Co.; E. W. Rice, Jr., Thomson-Houston Electric Co.; Wright Electric Engineering Co., Chas. H. Herrick, secy.; The Electric Gas Lighting Co,, by Louis W. Burnham, V. P. & Mgr.; Kendal & Slade;

American Waltham Watch Co., by R. Robbins, treas.; Simplex Electrical Co., by A. F. Mason, gen. mgr.; Paine & Francis; N. E. Wiring & Construction Co., by W. H. Francis, treas.; Wm. Brophy; Johnston Electric Train Signal Co., by W. C. Johnston, Jr. treas.; Edison Electric Illuminating Co., of Boston, C. L. Edgar, gen. mgr.

THE ENOS VOTE RECORDER.

The House Committee on Rules gave a hearing on July 28 to John A. Enos, an inventor, who seeks to have an appropriation of $60,000 made to defray the cost of installing his patent electric voting machine in the House of Representatives. Mr. Enos stated that during this session there have been over 300 roll calls, each consuming thirty minutes' time, or an aggregate of thirty working days, and he asserts by the use of his machine twenty-five days would have been saved.

WESTERN TRADE NOTES.

MR. THOS. GRIER, one of the managing engineers of The National Engineering Bureau, The Rookery, Chicago, has gone East to Philadelphia on a short vacation.

THE SPERRY ELECTRIC CO. are turning out their well known system of arc lighting as rapidly as possible, and find it difficult to keep pace with their large and numerous orders, so generally has the system, which is very durable and efficient, come into use.

MR. G. L. TEEPLE, a graduate of Cornell '88, who has been associated with the Western Electric Company, has resigned his position there and accepted the instructorship in Electrical Engineering in Dartmouth College.

THE CHICAGO INCANDESCENT LAMP CO., 13–17 N. Jefferson street, are about to double the capacity of their lamp factory. They manufacture incandescent lamps for any system, and their product is in large demand. Their lamps show a long life and high efficiency, and do not blacken. The demand has become so large that an increase in their manufacturing facilities has been rendered imperative.

MR. CHAS. G. ARMSTRONG, manager of the house goods department of The Great Western Electric Supply Company, has returned from his trip East, where he has purchased a very large and complete stock of electrical supply goods and specialties for electric light, telephone, telegraph, electric railway and power work. He has completed arrangements to handle the specialties of the New Haven Clock Company.

THE ILLINOIS ELECTRIC MATERIAL CO., The Rookey, Chicago, are doing a brisk business in electric supplies, Bishop white core wire, and other specialties. They have in hand a new switch, which will be placed on the market very shortly, and which possesses features of marked merit and advantage. They expect to do a very large business as soon as the Fall trade opens up. Their aim is to supply the best possible goods at reasonable prices.

MR. FRANK B. RAE, of the Detroit Electrical Works, was in town and a guest at the Electric Club last week. His company are very busy equipping a new surburban electric road, running out of Ft. Worth, Texas, with a complete Rae system of electric traction. The cars will be 35 feet long, with vestibule ends and equipped with double tracks, to each of which is geared a 30 horse power Rae motor, with which a speed of 25 miles an hour will be attained. They will be of the very finest finish and workmanship ever turned out by the Pullman Car Company.

THE ELECTRICIANS' TIME CO., 167 Dearborn street, Chicago, have issued a handsome little two-page circular enumerating the objects of their business, which are to furnish electricians and others with reliable watches protected from magnetism, which at the present time are a necessity, and also to supply other goods, such as diamonds, jewelry, silverware, etc., on easy payment if desired or for cash. A number of weighty testimonials are added, and the cuts of their special watches cause the circular, which is printed in colors, to present a very neat and attractive appearance.

MR. J. K. PUMPELLY, of the Pumpelly Storage Battery and Electric Motor Co., is now manufacturing a cell in which the electrolyte is absorbed by a special cellulose fibre which is placed in it between the plates and filling it up. The evaporation of the electrolyte is thereby greatly decreased and the resistance of the cell is not materially increased. The electromotive force also remains remarkably constant during the whole duration of the discharge. It is impossible for the acid to splash out, and the battery is admirably adapted for street car service.

MR. GEORGE H. R. PREBLE, of Tacoma, Wash., is in town and expects to return there in a week's time. He has been extensively engaged in electric work in that part of the country for some time, especially in street railway work. He has been examining with special interest the electric street railway supplies and specialties manufactured by the Electric Merchandise Company, of this city, and was found by your representative looking into these things, which were being explained by Mr. Mason, the general manager of the company. Mr. Preble when he returns will certainly be able to speak of the good things and latest developments in the art which he saw at their offices.

THE THOMSON-HOUSTON ELECTRIC CO., Michigan avenue, Chicago, are enlarging their offices on a most extensive scale, and will have one of the finest suite of offices in Chicago. They now occupy the entire building. On the ground floor will be located the central station, isolated lighting and stationary motor departments and the offices of Mr. Small. The partition heretofore dividing the floor from the stairway will be removed, and the large entrance space will be used as offices for the sales agents. Upstairs on the next floor, which is being beautifully decorated and finished in red oak, will be located the offices of Mr. B. E. Sunny, the Street Railway Department, Mr. Bailey, Mr. Wheeler, and Mr. Horne, the Engineering Department and a very handsome reception room, illuminated with 48 incandescent ceiling lights, tastefully arranged. This floor will be finished in terra cotta and blue papering, and carpeted to match. All the lights are regulated in sets by switches placed out of sight and easily accessible. The top floor will be used for light repairing and armature winding, and the dynamo repairs and heavy work will be done in the basement.

NEW ENGLAND TRADE NOTES.

THE NEW ENGLAND WIRING AND CONSTRUCTION CO. have received the contract for wiring the Middlesex County Court House at East Cambridge, Mass., for about 350 lights. Interior conduit will be used wherever practicable, and they will also furnish all the fixtures.

KENDAL & SLADE, Boston, have received the contract for the outside construction work for the Lynn and Boston Railroad Co. The line will be about eight miles long and will extend from the Lynn station to Wyoma. Single and double track will be used at different parts, and the system will be the overhead single trolley of the Thomson-Houston Electric Co.

THE TRIPP MANUFACTURING CO., of Boston, have recently made a shipment of their celebrated anti-friction journal bearings to the Chicago and Northwestern R. R. for passenger car service. Also electric car trucks to Concord Horse R. R.; Wilkes Barre and Suburban Street R. R.; Citizens' Cable Traction Co., Pittsburgh, Pa. The company is now manufacturing electric trucks for the following roads:

West Side Street R. R., Milwaukee, Wis.; Citizens' Street R.R., Indianapolis, Ind.; St. Paul City R. R.; Tacoma and Stellacoon R. R., Tacoma, Wash.; Vancouver and Electric R. R. and Lighting Co., Vancouver, B. C. The trucks manufactured by this company, equipped with Tripp's bearings for reason of simplicity and durability, are rapidly being adopted.

MR. WILLIAM D. WARNER, of 135 Pearl street, Boston, reports that he is furnishing large quantities of "Albumural" to electric light stations for painting their walls a pure white. Albumural is a fireproof and waterproof paint, and is used where ordinary kalsomining has proved unsatisfactory. It has an extremely white, glossy finish and never rubs off. Among the most recent electric companies to adopt Albumural are: Brookline Electric Company, Brookline, Mass.; Edison Electric Company, Newport, Mass.; Portsmouth Electric Company, Portsmouth, N. H.; North Adams Electric Light Company, North Adams, Mass., and many others. When applied it gives the station a clean and neat appearance, and being of an intense whiteness it brightens up the interior and saves a good deal of unnecessary lighting.

ST. LOUIS TRADE NOTES.

BROWNELL AND WRIGHT CAR CO. have just finished the shipment of 12 motor cars for the Cincinnati Street Railway Co., and 10 motor cars for the inclined Plain Plane Railway, all of Cincinnati. They are also engaged on large orders for cable and horse cars, and report that they are always crowded with orders.

MR. GUIDO PANTELEONI, Western representative of the Westinghouse Electric Co., reports the sale of a 60-alternating arc plant for Waco, Tex.; 80 arc and 1,500 incandescent for Ogden, Utah; and 40 arc with 500 incandescent for Carrollton, Mo.; also an isolated plant of four 500-light direct current dynamos to Moore, Bullene, Emery & Co., large dry goods merchants of Kansas City, Mo.

THE ST. LOUIS OFFICE of Westinghouse, Church, Kerr & Co. are putting in two 100 h. p. Westinghouse compound automatic engines, with line shafting and clutch pulleys of the latest improved pattern; also a 100 h. p. horizontal two plate tubular boiler for the Belleville Electric Light and Power Co., Belleville, Ills. They are also installing a 100 h. p. Westinghouse compound automatic engine at Lebanon, Mo., for the Lebanon Light and Water Co.

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New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.
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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers*

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Scientific knowledge makes the great man greater, adding to his powers, while it guards the weaker brethren from many follies.—Fleeming Jenkin.

THE ELECTRICAL PROPULSION OF VESSELS.

IN his able and interesting article that we publish this week, dealing with the subject of electric launches, Mr. Frederick Reckenzaun remarks that in a discussion of this topic we have to deal not with a new invention, but with an aggregate of inventions and experiments. Work in this field goes back, in fact, to the days of Jacobi, and antedates almost the whole of the development, that has now become so enormous, of the electric motor ashore. To-day, however, fifty years after the first successful demonstrations were made with crude apparatus, electrical propulsion for vessels remains an utter novelty to the vast majority even of educated and traveled people. In England, as might be expected of a country not only surrounded by salt water but submerged half the year in fresh, electric launches have been given a pretty good trial, and Messrs. Immisch have done themselves great credit by establishing a fleet on the upper Thames. But in this country, except the "Magnet," owned by Mr. Reckenzaun himself, we know at this time of no launches at all. There was one on the lake that broke its banks and destroyed Johnstown, but we have heard nothing of it since that memorable flood.

The time has certainly come when electric launches should be extensively used in this country. Having ourselves made trips around New York Bay and the Narrows, as well as up the Kills, with Mr. Reckenzaun, we can speak with knowledge of the great pleasure and comfort derivable from the operation of such craft, as well as of the absence of so many features that make boating disagreeable. The main consideration left now is that of expense, and on this point, the article gives some details that are trustworthy as well as figures that are well within the mark. Such fleets of electric launches as he proposes could easily be started, say, for example, on the Harlem in this city; on the Schuylkill at Philadelphia; on the Charles River at Boston; on the Potomac; on the great lakes at such points as Chicago, Cleveland, and Detroit; and on the ornamental waters of city parks all over the country. This is surely a field that deserves looking into and is worthy of development.

Moreover, a great many of the yachts in this country have their isolated plants, and to them a launch charged at fitting times, and always ready for lowering and for service, would be a great boon and convenience. This class of work, too, comes near to that required in the navy; and it is not to be overlooked that electric launches are already becoming part of the fleets of the leading maritime nations. Mr. Reckenzaun, who has long made a special study of the subject, points out other departments of usefulness, and we can readily believe that, once available, these boats would be in demand in many unexpected quarters. As it is, the sphere of ordinary commercial operations is large enough in itself to warrant attention being paid to the subject by those who are watching for new opportunities in electrical engineering.

TRIED AND FOUND WANTING.

MR. ELBRIDGE T. GERRY and his colleagues of the Commission appointed by the legislature of New York "to investigate and report the most humane and practical method of carrying into effect the sentence of death in capital cases," included in their report opinions which they had sought from judges, legal officers, electrical experts and physicians. Among them Dr. Wm. T. Plant, of Syracuse, thought that with proper apparatus and with proper skill electrical execution might be made certain and safe from mishap, "but," he said, "only actual trial can determine whether it is best."

The actual trial has been made upon Kemmler with formidable and elaborate apparatus of the kind advised by one of the most distinguished of the experts whose opinions were reported by the Gerry Commission. Making due allowance for the sensational character of the reports of the daily press, it is quite certain that the death of the victim at Auburn was not instantaneous, that respiration was resumed some minutes after the application and cessation of the current, that the current was turned on again, this time despatching the convict, but not without burning his flesh at the points of contact with the electrodes, and not till he had exhibited to the spectators meanwhile evidences of vital struggle not less revolting than those usually seen upon the gallows. This is the pitiable outcome, so far, of three years' work, beginning with the investigation and report of Mr. Gerry's Commission, followed up by the officious Medico-Legal Society, and accompanied by a series of experiments upon rabbits, dogs, neat cattle and horses at the hands of *soi disant* electricians and a few young physicians; the purpose of the work being to discover the "most humane and practical" way to kill a capital convict.

The execution of Kemmler though horrible, was not more horrible than many hangings have been. But the New York *Tribune* is mistaken in saying that "the only alternative is hanging." Mr. Gerry's Commission itself directed attention, in its report, as we have before pointed out in these columns, to a third method, to wit, poisoning, by use of the hypodermic needle, which was rejected because, in the words of the report:—"The use of that instrument is so associated with the practice of medicine, and as a legitimate means of alleviating human suffering, that it is hardly deemed advisable to urge its application for the purpose of legal executions against the almost unanimous protest of the medical profession." Poison in the form of liquid or gas can be administered with as much certainty of painless death as can be predicted of electricity, and probably more; and its employment for executing criminals would be far more "practical," requiring no machinery or elaborate apparatus. It would also insure immunity from all disfigurement of the body. It would be neither sensational nor experimental—two attributes of the method just put into operation that fully justify the conclusion that the philanthropic Commission and the legislature have not succeeded in providing the most humane and practical means for carrying out the sentence of death.

CENTRAL STATION STATISTICS.

The electrical figures in the census of 1880 were of the most meagre and unsatisfactory kind. The telegraph data was the most complete, because ten years ago telegraphy was the great electrical industry. But the telephone was hardly noticed, and all the rest was a blank—an undiscovered world where the census agent had never set foot. This year, however, the indications are that the census of electrical industries will be of the most complete nature possible. We have just received from Mr. Allen R. Foote a set of the schedules for central stations, and find them in every way excellent. We trust that the figures asked for will be supplied fully, or if not fully, with the nearest approximation. The result can only be as Mr. Foote says: "An exhibit of American genius, skill and enterprise, of which the nation will be proud, and which will be the marvel of the country." The other schedules prepared by the special agent are equally well drawn, and we hope that the figures from each industry will leave no cause for complaint on the ground of incompleteness or inaccuracy. The central station schedules will be distributed in three or four weeks, and we bespeak for Mr. Foote the utmost cordiality of support in his arduous work.

Series Storage Batteries.

The practice of joining each set of plates in a storage battery in multiple—the first employed in the art—has become so universal that all other possible methods were, until recently, entirely neglected. It would appear, however, that at last proper attention is being given to this detail, in the employment of plates, which are placed in series so that each cell has an E. M. F. depending on the number of plates which it contains. On first consideration it might seem immaterial so far as the watt-hour capacity of a given cell is concerned whether its plates be arranged in parallel or series, but when we consider many special applications, especially those involving transportation of the cells, as on street cars, certain advantages in favor of the series cells become more apparent. Greater economy of operation can frequently be obtained by the use of high E. M. F. and small current for a given amount of electrical energy expended, and in such cases the series battery, with its increased E. M. F., can be applied with great benefit. Again, in portable installations, the smaller number of cells required is an important factor. The series cell designed by Mr. Dey and described in this issue ought to fill a place which until now has remained unoccupied, but which seems capable of considerable extension.

Electric Railways and Ocean Cables.

The interference of the electric railway operated parallel to the lines of the Commercial Cable Co., which was pointed out by Mr. Charles Cuttriss in our last issue, has called forth an interesting contribution from Mr. T. D. Lockwood, in which he discusses the probable explanations of the apparently anomalous case. Thus, while admitting the possibility of leakage from the earthed railway conductors, Mr. Lockwood emphasizes the point that the existing arrangement cannot strictly be considered as a complete metallic circuit. But he goes further and shows that the static arrangement and conditions can easily be made to account for the phenomena, aggravated as they are and almost entirely due to the burial of the cable conductor in the earth. Naturally, Mr. Lockwood, with his telephonic leanings, considers the electric railway as the trespasser in this matter, and holds that the most simple remedy to be applied should come from that quarter, by the application of the double overhead trolley system. While the efficacy of this method cannot be gainsaid, it seems doubtful if it will be applied, after recent decisions of the courts in similar cases. On the other hand, with the nature and cause of the disturbance thoroughly understood and verified, the remedy can, with probably far greater facility, be applied to the cable.

Converting Alternating into Continuous Currents.

In the early days of alternating current apparatus, when its practibility as compared with that for continuous current was the most prominent topic before electrical engineers, the objections that were raised to it were numerous. Among the more prominent of these was the fact, as then supposed, that it was not adapted for the operation of motors. This objection, or rather shortcoming, has now disappeared with many others of a like nature, but there is still one application in which the alternating, as such, can not be used, and that is, in the charging of storage batteries and electrolytic work generally. True, it was early suggested that by means of a revolving commutator the alternating current might be redirected and the object sought for thus attained; and our readers will also recall Mr. Tesla's more recent ingenious method of reaching the same end by various methods, all based on the principle of providing two paths for the alternating current, each of which allows the current of only one polarity to pass beyond it to the circuit. That the problem is still before the eyes of electrical inventors is shown by the neat device due to Messrs. Zipernowsky and Deri and illustrated on another page.

THE TESLA MOTOR IN MINING WORK.

THE alternating current system of electrical distribution has recently demonstrated its great usefulness on a new field by proving a wonderful success in mining work.

The Willock mine, belonging to the Monongahela Gas Coal Company and situated in the first pool of the Monongahela coal region, is now operated with a complete plant of this system. Alternating current motors are utilized as a source of power in the production of the coal, the working of the pump and also in the manipulation of an enormous ventilator which keeps a constant draught of pure air in the mine. In addition to that, the mine is also illuminated by the alternate current system.

Inasmuch as this is the first mine in the Pennsylvania coal region where the alternating current system is utilized very extensively, our correspondent made a visit to the mine in order to make a personal investigation of the success of the plant. He was very much aided in his efforts, by Mr. John Werner, the mill boss, who believes that electric mining has no greater prospect anywhere than just in the coal fields of Pennsylvania. The reasons for this are many. In the first place, coal mining in Pennsylvania was never such a poor trade as it is now; in fact, it is so bad that a native born American will have nothing more to do with the work. The result has been that the business has fallen into the hands of foreigners of the very lowest class, such as Hungarians, Poles and Italians. Then again, the price of coal has gone down to such an extent, induced of course by competition, that it is impossible to get any intelligent men who will do the work for the small wages a miner is able to make. This condition of affairs caused the coal operators to hail the advent of electricity as a coal miner with great delight, and it will probably not be very long before every mine in the country will be operated by electricity.

The advantages afforded by electricity in the operation of a mine are so manifold that its use is bound to become general. For instance, where a coal digger was able to earn on the average $2.25 per day, the machine miner makes $3. This is possible, because, while the operator pays the miner less for the production of each ton of coal, the man can produce so much more with the aid of his machine that he can make better wages now and the work is less laborious. The operator pays the coal digger 79 cents per ton of coal, but the production of each ton with the aid of electricity costs him only 49 cents, so that there is a pure gain for the operator of 30 cents for each ton.

The plant consists of a thirty h. p. Tesla quarter-phase generator of a capacity sufficient to carry seven motors when cutting coal, at the limit of the capacity of the coal company. The generator is self-excting, self-regulating, and so wound that as the load increases, the E.M.F. rises. By the aid of a hand rheostat, the adjustments can be so made that the falling off in the speed of the engine and the drop in the line may be compensated for, so that at the motors a very close approximation to constant E.M.F. is obtained. After the hand rheostat is once adjusted, it is unnecessary to make further adjustments, for the self-regulating devices are automatic. Three wires are carried from the collector at the end of the generator shaft to the switch board and pass through the switch board instruments and main line switches directly into the mine. On the switch board is a direct reading voltmeter and an ammeter. The E.M.F. at the motor is 300 volts in this installation. Where the distances becomes very great, a higher E.M.F. may, of course, be used.

The mine is wired with high class rubber-covered wire, and the insulation of each wire is practically continuous from the point where the wire leaves the main switch in the power house until it reaches the end of the circuit. At the entrance of each room, and also at convenient points throughout the mine, switches are located and safety catches inserted. This insures safety from short-circuiting and also allows any portion of the circuit to be cut off from the generator without interfering with the work in other parts of the mine. From the switch in the room to the coal cutting machine the current is carried by a three-wire cable. This cable is highly insulated and covered with a protecting braid, and though it is frequently allowed to lie on a damp floor and even in pools of water,

THE TESLA MOTOR DRIVING A HERCULES MINING MACHINE.

no inconvenience is noticed arising from this usage. Owing to the simplicity of the alternate current motor it is necessary only to have a jaw switch at the motor with which the circuit can be opened and closed. No regulator of any kind is used, and the only auxiliary apparatus connected with the motor, with which the operator of the machine has anything to do, is the switch to turn the current on and off. The motor is completely covered and the chance of getting a shock through careless handling is nil. Our illustration shows the motor mounted on the drill.

The mine owners are well satisfied with the performance of the plant and the men bring out from 45 to 50 tons of lump coal with each machine per day.

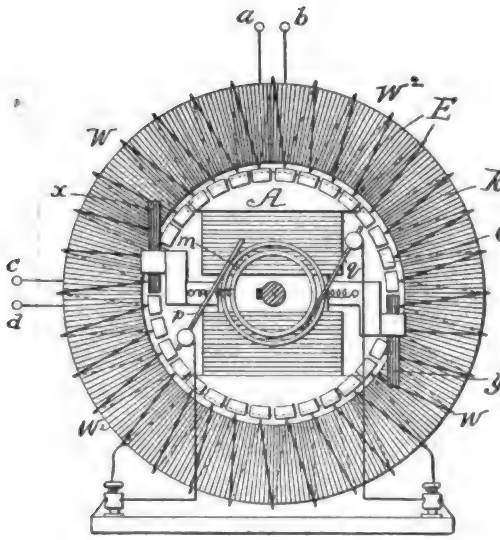
The coal mining machine used at this mine is the Hercules machine, and the entire electrical equipment was carried out by the Mill and Mine Electric Equipment Co., of Pittsburgh, Pa.

THE ZIPERNOWSKY-DERI CURRENT CONVERTER.

While the alternating current can now be applied directly to nearly all purposes of electric lighting, power transmission, etc., there are still cases in which the continuous current alone is applicable, such for instance as the charging of storage batteries and electrolytic purposes generally. To effect these objects, it is necessary to convert the alternating into a continuous current, and a neat method has recently been devised by Messrs. Zipernowsky and Deri, of Buda Pesth.

The apparatus consists essentially of an alternating motor combined with a Gramme machine in a very ingenious way.

The manner in which this is carried out is illustrated in the accompanying engraving. Here the ring magnet E is



The Zipernowsky-Deri Current Converter.

is wound with two pairs of coils W and W², with terminals *a b* and *c d*. Through these terminals the alternating currents are supplied to the two pairs of coils, so that the current supplied to one coil lags behind the other a quarter of a wave-length. Besides these two pairs of coils there is wound upon the ring a third coil E, which is in the nature of a secondary coil, for the induced currents. Divisions of this secondary coil are connected up to corresponding sections of the fixed commutator C, after the manner of a Gramme ring, for the production of the continuous current.

Within the ring E is the iron armature A, keyed to the central shaft, so as to be free to rotate within the ring, and the armature also carries the pair of brushes *x y*, bearing upon the fixed commutator C and electrically connected to the two contact rings *m n* on the shaft. The iron armature will always seek to lie in the direction of the magnetic axis, and therefore will rotate synchronously with it. The brushes, being once for all placed on the neutral points and being rotated by the armature, will keep on the neutral points.

To make the apparatus start easily, the rotating iron armature is furnished with a coil closed upon itself, so that currents are induced in the coil in starting, increasing the torque between the armature and ring-magnet. As soon as synchronism is reached, these currents in the closed coil disappear.

It is evident that with the apparatus described, continuous currents may also be converted into alternating currents if the greatest part of the continuous current supplied be led through the contact-rings *m n*, and through the brushes, for instance, into the commutator, and so into the coils for continuous currents. A small part of the current is employed, however, to effect the magnetization of the armature. By that means the apparatus will rotate in the same manner as a continuous-current motor, and there will be produced in the coils for the alternating currents two alternating currents, the phases of which are relatively shifted by one-quarter of a wave-length, and which are led off from the terminals to be used as desired.

A PROOF OF MAXWELL'S THEORY OF RESIDUAL CHARGES.

BY H. MURAOKA.

According to Maxwell's theory no residual charge can appear in a perfectly homogeneous dielectric, whereas parallel layers of various dielectrics, each homogeneous in themselves, will give a residual charge, provided none of them is a perfect insulator. The first part of the theory has been already established by the researches of Rowland and Nichols, Hertz, Arons, and Dieterici. The author of this paper succeeded in proving the truth of the second part by Dieterici's method He superposed layers of two of the dielectrics, paraffin oil, petroleum, castor oil, oil of turpentine, xylol, paraffin and air, and with some exceptions found considerable residual charges. The exceptions occurred when two good insulators or two miscible fluids were chosen. When one dielectric is soluble in the other, as for instance paraffin in xylol, the residual charge disappears. Maxwell's view would lead one to expect a residual charge where the dielectric consists of microscopically minute particles of different substances. This, therefore, cannot be the nature of the solution.

THE LINEFF ELECTRIC TRAMWAY.

This system, which was illustrated in our issue of July 23, has just been favorably reported upon by Mr. Gisbert Kapp, who calls attention to the novelty of the double set of magnetic rails. He has tested the line by taking a steam roller over it, and then drenching it with water for 26 hours, after which no fall of insulation was found, the resistance being 3,400 ohms. Tests at different speeds showed that two feet of rail under the car at either end were out of circuit. The only criticism made in the report relates to the power required to propel the magnet. This amounts to only half a horse-power at seven miles an hour, and Mr. Kapp indicates means of reducing it.

THE RADIOMICROMETER.

In an interesting communication by Prof. C. V. Boys to the Royal Society on measurements of the heat of the moon and stars by means of his radiomicrometer, he gives an account of a test with a candle at 250.7 yards distance, which gave a deflection of 38mm. If ¼mm. be taken as the smallest deflection which can be observed with certainty, the instrument, as made and used by him, would show the heat of a candle at 1.71 miles distance, neglecting the absorption by the air.

ALTERNATING CURRENT CENTRAL STATION AT ROME.[1]

BY DR. J. A. FLEMING.

This has been characterized by Professor Forbes as "the finest example of an alternating current central station," and it well deserves this commendation.

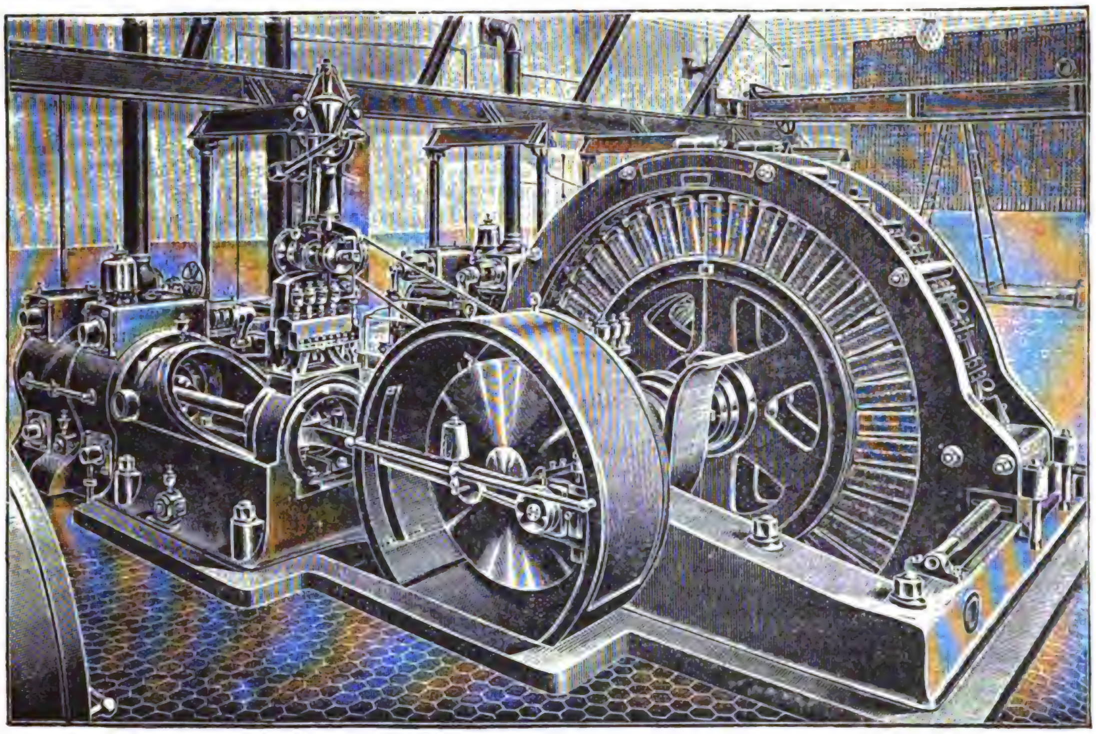
Since his account of it an addition of two 600 h. p. engines and dynamos has been made and the plant has at the present time a capacity for 24,000 sixteen c. p. lamps.

The electric lighting of Rome is carried out by the gas company, which has enlarged its operations and exists under the denomination of the Società Anglo-Romana per l'Illuminazione di Roma col Gas ed altri sistemi. The Directors of this Company were wise and far-seeing enough to recognize the necessity of dealing with the electric light either as an ally or as a rival, and in the spring of 1886 commenced operations for the supply from the gas works of the electric current by the Ganz alternating system. The gas works at Rome are in the Via dei Cerchi, near the Tiber, under the shadow of the Mount Palatine, and occupy a position in the region of old Rome, near the site of the ancient Circus Maximus; and in building the foundations of portions of the heavy dynamo machinery some of the old arches of the Circus were exposed.

The central station plant consists of two similar small alternators of a power of 80,000 watts giving a maximum current of 40 amperes at a pressure of 2000 volts, which are coupled direct to engines of 125 h. p., and of four large alternators of 320,000 watts, each giving a maximum current of 160 amperes at a pressure of 2,000 volts. The large dynamos are coupled direct to compound steam-engines working up to 600 h. p.

Commencing the description with the first two, or smaller machines, these were placed in position, and began to be used in the autumn of 1886. The engines are single-cylinder high-pressure engines by Gebrüder Sulzer, of Winterthur and Ludwigshafen. The speed is 250 revolutions per minute. Each horizontal engine is built on a common bed-plate with the dynamo, and the revolving field-magnet of the dynamo forms the flywheel of the engine. The engines can be worked up to 150 horse-power. There are 20 coils in the fixed armature, and 20 poles in the stellate field-magnet, and in the armature all the coils are joined in series, each giving 100 volts, or 2,000 in all. In the field-magnets the coils are arranged in two series of 10 coils each, joined in parallel. The alternations are 5,000 per minute, or about 42 complete periods per second. These dynamos are auto-excited by a rectified alternating current and commutator, taking current from the secondary circuit of a field transformer, of which the primary coils are in connection with the armature of the alternator.

The larger dynamos (placed in position and started in November, 1887) are separately-excited alternators, coupled direct to 500 horse-power compound engines by Van den Kirchoffe, of Ghent. These last have elaborate expansion valve gear of the Corliss type, and also centrifugal governors of the usual kind. The dynamo is placed between the high-pressure and low-pressure cylinder, so that the field-magnet is slung on the centre of the steel main shaft. The ring-shaped armature frame has massive projections or lugs on either side, supported by, and traversing in, guide bars like the bed of a lathe, and it can be traversed laterally by a screw, so as to move it off from and expose the field-magnet revolving in the interior. The interior diameter of the armature ring frame is about nine feet and a half, and the over-all diameter of the stellate field-magnet rather more than nine feet. In the large dynamos, Nos. 3 and 4, the field-magnets have solid cast-iron cores and wrought-iron polar caps or projections; and these magnets, 40 in number, are placed round the periphery of an iron wheel keyed on the main shaft. The armature cores are built up of plates of thin sheet iron with interposed paper. The two smaller dynamos also have armatures built in this way, with divided iron cores and solid cast-iron field cores with sufficient pole pieces. Their armatures are composed of 40 coils, each one developing a potential of 50 volts, and these bobbins are joined in series. In the field-magnet the 40 coils are joined up so as to make two series of 20 each, which work in parallel. The engine makes 125 revolutions per minute, producing thus a current of 5,000 alternations per minute, or 42 complete periods per second. The armature coils will carry safely 200 amperes, but their normal load is 160. The copper wire on the armature and magnet coils is 6mm.—about one-fourth inch—in diameter.



Ganz Alternating Current Station at Rome, Italy.

1. Abstract from the London *Electrician*.

The last two large machines, No. 5 and No. 6, are generally very similar to No. 3 and No. 4. They are driven direct by compound 500 horse-power engines by the Erster Brünner Maschinen Fabrik of Austria; and in this case also the dynamo field-magnet is slung as a flywheel in between the high-pressure and low-pressure cylinder. In order to give space for the stellate magnet and annular armature frame, a pit is formed between the high-pressure and low-pressure part of the engine. These last engines have governors of the type employed in the well-known Armington and Sims engine, in which the lead of the single eccentric is shifted and controlled by the outward movement of two massive weights contained in the interior of a pulley-shaped governor wheel. This governor is, for convenience, placed on the outside end of the main shaft of the engine. The general appearance of these last two 500 horse-power dynamos is shown in the illustration. These engines have been found to do their work remarkably well and to govern steadily.

In these last dynamos, No. 5 and No. 6, the cores of the field-magnets, as well as the armature cores, are built up of laminated iron. The bobbins of the field-magnets are formed of rectangular split zinc frames, about 15 in. high and 20 in. wide. They are wound over with the insulated wire, but more wire is placed at the bottom of the frame than at the top, and the finished bobbins have a slight taper from about 8 inch to 6½ inch in end width. The armature bobbins are shallow rectangular bobbins, wound on vulcanized fibre frames about 19 inches long and 10 inches wide and 2 inches deep. Each bobbin has on it about 30 turns of highly insulated copper wire, about 6 mm. or ¼ inch in diameter. The armature coils when slipped on to the laminated iron cores are kept in position by bobbin holders of bronze, which form a kind of skeleton frame clamped on the end. The more massive electro-magnet bobbins are secured by a similar bobbin holder, and by a bolt fastening it which traverses the whole width of the laminated core. The terminals of the field-magnet circuit are led to two insulated brass pulleys, deeply grooved, which are secured on the shaft. Over these are slung flexible copper stranded cables, one end of which carries a pendant weight, and the other end of which is in connection with the exciter circuit. This affords an excellent and yet a perfectly flexible contact surface, for the exciter current to enter and leave the alternator field-magnets. The mechanical performance of these latest machines is very excellent; the dynamos run very smoothly and quietly, and give no trouble by any heating or insulation defects.

To excite these four large dynamos, there are three exciters driven direct by Westinghouse engines of 50 horse-power each, made by Alley and Maclellan. The exciting dynamos are by Ganz and Co., and are four-pole continuous-current machines, which, at a speed of 375 revolutions per minute, give a current of 150 amperes and pressure of 180 volts.

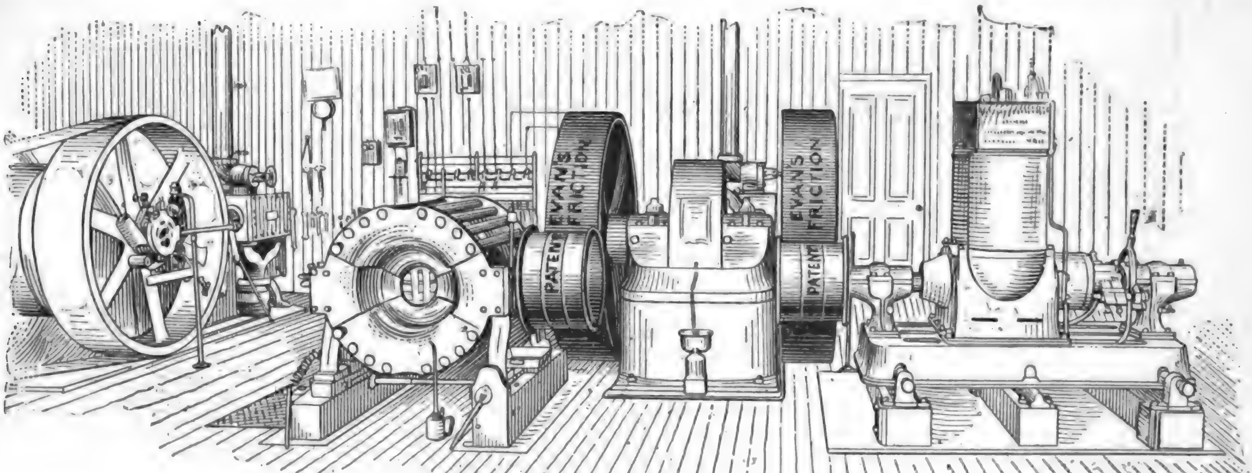
Since 75 amperes is a sufficient exciting current for each of the large dynamos, one exciter can excite two of the large dynamos, and hence there is always one exciter in reserve. At full load the power absorbed in exciting is said to be 3½ per cent. of total absorbed power. The steam is provided from a plant of fourteen Babcock and Wilcox tubular boilers, each of 160 nominal horse-power. Coke is burnt in the furnaces. Four steam pumps, in addition to the usual injectors, supply water to the boilers. The total boiler horse-power is 2,240 h. p. The steam pressure is 120lbs.

There are, therefore, in this station three pairs of machines, each pair consisting of two similar independently driven dynamos, but all yielding a current at the same electromotive force, and having the same frequency of alternation.

EVANS FRICTION CONE DRIVING, AT HUTCHINSON, KANSAS.

We have already described in these columns the interesting method of driving dynamos employed by the Evans Friction Cone Company, of Boston, and have noted a number of plants in the East in which the system has been employed with success. We now illustrate an installation on the same system in the electric light station at Hutchinson, Kan.

The dynamo at the left is a Thomson-Houston "M. D." machine, with a capacity of 50 full arc lamps, and the machine is fully loaded. The Edison machine is a No. 16, of a capacity of 720 incandescent lamps. Both machines are driven from the fly-wheel of an Armington and Sims engine. This plant has been running constantly since January, 1890, and is giving entire satisfaction in every respect. The saving in room effected in this plant, as well as the economy in belting, the smooth running, etc., have attracted considerable attention among Western electric light men.



Evans Friction Cone Driving, Hutchinson, Kan.

ELECTRIC ETCHING.

The *Papier Zeitung*, of Berlin announces that an important discovery has just been made in etching, and especially in photogravure. As usual, the drawing is traced on a plate of zinc, either by an artist or by photography, with any suitable etching ground. This plate, backed with asphaltum, is laid in a bath of dilute acid. It is then put in circuit with a dynamo, the other pole being merely placed in the acid. When a current is allowed to pass, the acid attacks the metal with surprising rapidity. A few minutes suffice to bite the plate, and the depth of the etching can be easily controlled. The action is probably due to the depolarization of the surface of the metal, which in the ordinary method of etching becomes covered with a film of hydrogen, or, at all events, with a number of minute bubbles, which make the biting irregular unless the plate is incessantly rocked and brushed.

THE DEY SERIES HIGH POTENTIAL STORAGE BATTERY.

In our issue of last week we drew attention in a short note to the appearance of a so-called "series" storage battery which had been brought out in England and was designed more particularly for small work, such as carriage lighting, etc. In this battery, it will be remembered, the individual plates were positive on one side and negative on the other, so that the potential of the cell was equal to 2 volts for every plate.

We have now had our attention called to a similar type of cell which has been in operation in this city for some time past, and on which the patents were granted over a year ago. It is the invention of Mr. Harry E. Dey, of this city.

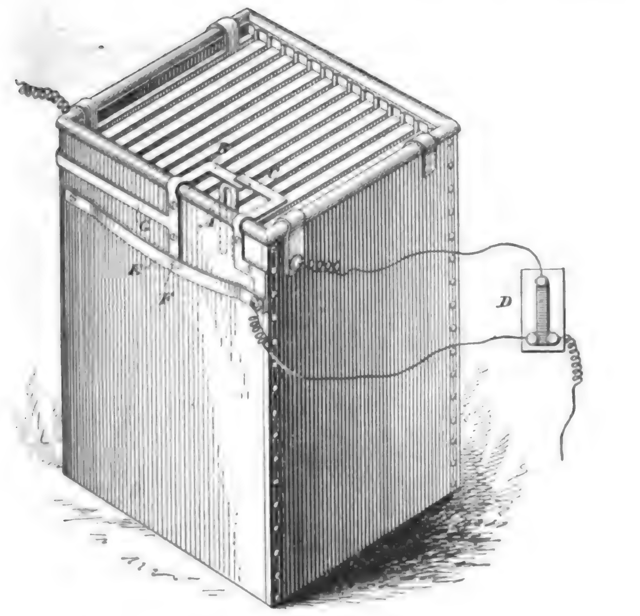


Fig. 1.—The Dey "Series" High Potential Storage Battery.

Beginning with the outside case, Mr. Dey uses hard rubber made from sheets that are screwed together. This is lined with a soft rubber box having cleats or ribs running down the sides and across the bottom. The lead plates, which have a raised rim, slide down the grooves formed by these ribs, and when the side is screwed on it forms water tight joints between the ribs and plates. On the bottom the ribs are about an inch deep and run up to a point forming a tongue between the plates, thus keeping any active material which may fall from short-circuiting the plates.

The plates are 9x15 inches, and the main body is $\frac{7}{16}$ inch thick, the rim being raised above this $\frac{1}{8}$ inch, and they are placed $\frac{3}{8}$ inches apart. A complete cell, as shown in Fig. 1, contains eleven whole plates and two half or end plates, and weighs 210 pounds; it has a normal output of ninety-four ampere hours, and an E. M. F. of 24 volts, or 2276 watt hours, which is equivalent to over three horse-power hours. Mr. Dey claims that he will double this output with the same weight with a new plate that he is experimenting on.

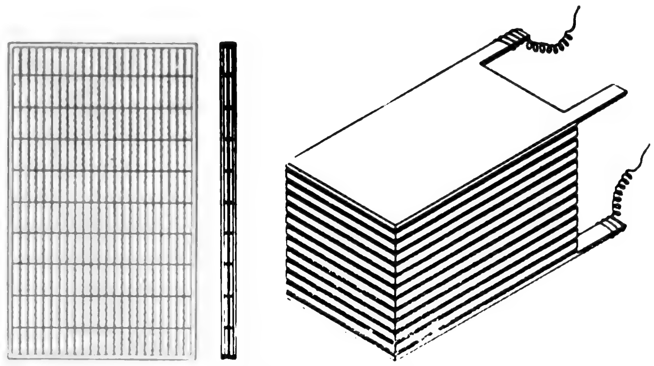
The plates at present in use are made grid fashion, with a web or partition down the centre and projecting half an inch above the active material to keep the acid separated, as shown in Figs. 2 and 3. The ribs of the plate form rectangles $\frac{3}{8}$x$1\frac{1}{2}$ inches and are $\frac{3}{16}$ inch deep on each side of the web. To keep the active material from falling out, a round-pointed knife blade is drawn across at every quarter inch, which forms hooks reaching out over the active material, making it impossible for it to fall out.

The active material is applied in the form of a dry powder, red lead being placed on the positive side and litharge on the negative. It is pressed in just hard enough to bear light handling, and is then piled up with sheets of felt saturated with dilute acid, as shown in Fig. 4. Wires are connected to the upper and lower plates and a strong current passed through, which immediately forms them almost as fast as they moisten, positive on one side and negative on the other, in the fashion of a voltaic pile. Contrary to plates formed in a jar, they form on the surface first. The pressure of the plates piled on top of each other keeps the material very compact while forming.

Mr. Dey has constructed a cell that had two of its plates made according to the "paste" method and the rest with dry powder, and as the plates were all in series they all received the same current and usage. This cell accidentally had a fall which broke the case into fragments but did not injure the plates. The pasted ones were found to have scaled badly, and were also badly sulphated and buckled, while those formed with dry powder were in as good condition as when placed in the case. A comparison of the two convinced Mr. Dey that dry powder was far superior to the paste.

One advantage of this form of cell, as pointed out by Mr. Dey, is that when they do buckle (which occurs rarely) they all buckle in one direction (positive side out), and fit into one another like saucers. Another advantage is that the plates are not in any way connected, and a defective one can very easily be removed at any time, and a perfect one substituted; besides, a short-circuit short-circuits one plate only, instead of a whole cell, as is the case with the usual type of storage battery.

In connection with the new cell Mr. Dey also employs some very ingenious cut-outs. One for cutting out the battery when fully charged is made with a light inverted U-shaped tube, A, shown in Fig. 1, which is filled with acid and hung on the plate into the solution. A spring, B, projects over this, and a strip of metal, C, over the spring, one being connected to one pole, the other to any alarm or cut-out device, the cut-out being also connected to the other pole. The gas arising from a fully charged cell rises into the tube, displaces the acid and raises the tube against the spring. The latter thus comes in contact with the strip, C, making a contact that operates the cut-out.



Figs. 2, 3 and 4.—The Dey "Series" Storage Battery.

Another cut-out is used in case a battery is being charged too fast and heats. This consists of a strip of metal, E, that extends across the box and is fastened to it at each end and bows outwards. Under the bowed part is a pin, F, which is normally out of contact with the strip, G, but the expansion of the hard rubber, caused by the heat, draws the strip down in contact with it; and as the pin and strip are connected to the poles, as in the preceding case, it acts likewise to cut out the cell. In practice Mr. Dey combines the two cut-outs in one.

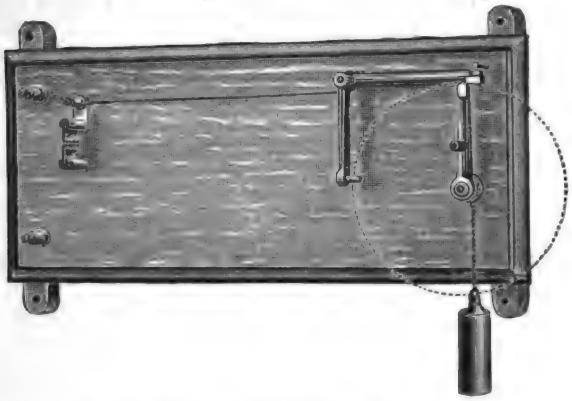
The Sawyer-Man Electric Co. have had fifty of these cells made. They use eight of them in their Boston office, and the remainder at their office and factory in this city. They have two series of six cells for their photometer room, giving an electromotive force of 144 volts. The rest are connected up in series of three, each series giving 72 volts for their lighting circuit. Mr. Dey does not pro-

pose to limit the use of his cells to lighting carriages and other small work. He claims that they will do the work of any other battery, besides being applicable in many fields that other batteries cannot enter. Thus an arc lamp works nicely on two cells. Again, with smooth streets, we would probably soon see all vehicles run by electricity, as with these batteries a carriage can be run with two or three cells; all that is necessary are numerous sub-stations where the batteries may be charged or left while not in use, in the same manner as a horse would be stabled.

BAIN'S HOT WIRE LIGHTNING ARRESTER.

A LIGHTNING arrester, to be practical, should evidently protect the circuits when they are idle with as great fidelity as when the dynamos are in operation. It should ordinarily be so constructed as to have no self-induction, and an absolute break of sufficient distance to interpose enough resistance to open the arc should be made with every flash of lightning that comes in on the lines. These breaks should be absolute and not depend upon any equilibrium mechanism for the length of break; they should be automatic, so as to take care of a number of flashes in rapid succession without any manual attention, and a further requirement is that they should protect circuits used for alternating currents with an equal degree of promptness and certainty as circuits which are used for straight currents.

A device fulfilling all these conditions has been recently designed and patented by Mr. Forée Bain, of Chicago. The accompanying engraving shows how the circuit to



BAIN'S HOT WIRE LIGHTNING ARRESTER.

ground is absolutely opened through the expansion of a small iron wire, due to the passage of the flash or the dynamo current. The iron wire forms a part of the circuit to ground, and as the lightning leaves the line at the comb it passes over this wire, which is expanded. A spring acting against the wire causes the trigger to unlatch the metallic winch, which forms part of the circuit, and to this winch is attached a string, wound round a drum, which is a part of the winch. To the string is hung a small weight, which causes the winch to revolve when released, so that when the wire has been expanded by the passage of current the winch makes three-quarters of a revolution and stops against an insulated stud on the arm, part of which forms the trigger. It then rests against this insulated stud, leaving the circuit to ground open until the wire contracts sufficiently to release it from the stud, when it completes the revolution and once more rests against the trigger and is ready for another flash to repeat the operation.

This arrester is said to be thoroughly reliable, and may be placed on either side of converters on alternating circuits, or in dynamo rooms on either alternating or continuous current circuits. In actual operation the wire does not get warm enough for the heat to be detected by touch.

The Central Electric Co., of Chicago, have taken the agency for Mr. Bain's arrester.

AN ALL-COPPER RAIL BOND.

IN electric railways with overhead wires, the resistance of the ground return, and the consequent loss of energy, will depend largely on the connection between adjoining rails. The various forms of rail-bonds now in use are made wholly, or in part, of iron and still leave better conductivity to be desired. To fill this want, The Great Western Electric Supply Co. are making a rail-bond entirely of copper. The cut shows the two end pieces and

AN ALL-COPPER RAIL BOND.

part of the connecting wire full size. The taper pieces fit into holes drilled in the rails, and when upset in place they form a good metallic connection. The connecting piece can be made of any desired diameter and length, to suit the different circumstances, and can be bent to meet any unusual change. This rail bond does away with the brass and iron pieces formerly used, and should give a joint of practically no resistance.

IMPORTANT WORK OF THE N. Y. STATE RAILROAD COMMISSION.

The State Railroad Commission has approved the form of grooved rail which the Third avenue road, in New York City, will lay down when it changes its motive power from horses. The company, in its application, presented a form of grooved rail which it asked the board to approve in case it did not favor the tram rail, which was also presented for approval at the same time and was desired by the road. The rail approved by the board is a cross section of rail not less than seven inches deep, the head of which is to be not less than two inches. The grooves shall not exceed one and one-quarter inches in width at the top and three-eighths of an inch at the bottom, with a depth of one inch.

The thickness of the metal forming the inner side of the rail shall not be less than five-eighths of an inch at the surface and the upper surface of the same shall not be more that five-sixteenths of an inch lower than the head of the rail bed, and the general construction of the pavement is to be laid in conformity with the requirements of the Commissioner of Public Works. The form of grooved rail suggested by the company and approved by the board does not meet the ideal requirements of street surface rail. In the opinion of the board it is so much better, however, than tram rail that the board concluded to approve it, particularly in view of the fact that it is in practical successful operation in other large cities.

The board favored a simple groove not exceeding seven-eighths of an inch opening at the top and of the same depth, with the surface of the rail on each side of the groove flush with the pavement. The strenuous contention, however, upon the part of railroad companies that a wider groove at the top and a slight depression of five-sixteenths of an inch of the inner surface would be absolutely necessary to permit dirt and ice to be worked out of the groove, led the board to approve of the cross section as submitted by the railroad company.

The commission also approved the application of the Coney Island and Brooklyn Railroad for permission to change its motive power from horses to electricity upon that portion of its road upon Sea Breeze avenue from East Fifth street to West Fifth street, on condition that the rate of speed of its cars shall not exceed that to be determined by the Highway Commissioners of the Town of Gravesend, and that no car shall be operated with less than two men in charge.

MOTORS VS. STEAM ENGINES IN CHICAGO.

The last piece of steam propelled machinery has now been dispensed with at the Columbia Theatre. The fires have been drawn from the furnaces and no more complaints can be brought against this house for burning soft coal. Electric motors now furnish all the required power, and the change is one which is thoroughly appreciated by every one concerned.

ELECTRIC LAUNCHES.

BY FRED. RECKENZAUN.

Whenever we allow ourselves to indulge in a retrospect on historical events, be it for our own enlightenment or for the purpose of gathering a suitable assortment of specific references with which to introduce the discussion of a certain subject, we are apt to take special cognizance of such facts and features as reflect their characteristics strongest upon the point of view chosen.

In discussing the subject to which this article is devoted, we do not deal with a new invention, but with an aggregate of inventions, which individually have been, and possibly will be, from time to time, exchanged for others of a different class. Before entering upon an analysis of the electric launch of the present day, we will, therefore, briefly review the principal features of its history.

The idea of applying electricity to the propulsion of vessels is as old as that involving the employment of the same agent for traction purposes. Indeed, electrical navigation was an experimental fact, not a mere idea, over half a century ago. Being first conceived and demonstrated by Prof. Jacobi in Russia, during 1838, his fascinating achievement was followed up in England by Robert Hunt early in the fifties; by G. E. Dering in the year 1856, and in France by Count de Moulins in 1866. In all these experiments electro-magnetic motors and primary batteries of various descriptions were employed to actuate the propeller. The results obtained, although demonstrating the possibility of electrical navigation, failed, however, to prove its commercial feasibility. This was due, not to a lack of versatility on the part of the projectors in effecting suitable combinations of known devices, but to the very absence of such of the latter as were essential to success. Not only were the batteries themselves cumbersome, bulky, of comparatively small capacity, and expensive in operation, but the motors added to the disadvantage by their low efficiency.

With the advent of the dynamo electric machine—that great helpmate to which so many dormant inventions owed their revival—the subject of electric boats gained in feasibility. The storage battery, which was of little use without an economical generator, came forward in commercial form, while the reversibility of the dynamo itself was productive of a highly efficient motor. With the storage battery in place of the primary battery and a new type of electric motor in place of the old ones, the electric launch entered upon a new era.

Trouvé availed himself of these improvements in 1881 in Paris, but also employed a primary battery of his own; his experiments were the first with storage batteries and the last notable ones on record with primary batteries. In 1882 the Electrical Power Storage Company, of London, brought out the launch "Electricity," designed by Anthony Reckenzaun. During the years following, electric launch building gradually developed into a distinct branch of electrical industry, especially in England, where the advantages of this class of craft for pleasure purposes have met with such increasing appreciation and favor as to cause the establishment of a series of charging stations along the Thames river (by Messrs. Immisch & Co.), where a whole fleet is in use now, while a regular passenger service by electric boats has quite recently also been introduced at Edinburgh, Scotland.

We will now proceed to the main object of this article —the discussion, from an electrical point of view, of the principal details of construction and equipment of a modern electric launch.

THE HULL.

The hull of an electric launch need not materially differ from that of a steam or naphtha launch. The shipbuilder's work remains the same, only the interior or joiner's work requiring adaptation to the different nature of the equipment. By this is not meant, however, that any sort of hull will give satisfaction. Before we have it built it is well to know what we are going to put into it—the kind and size of motor and the number and size of battery cells. Space is limited on all sides, and the features of the hull, motor and battery should be carefully considered in their mutual relations.

After we have roughly modeled the lines, either in accordance with the shipbuilder's practice, or to suit a special fancy, it will be of advantage to lay down upon paper the cross sections, taken at suitable distances apart from bow to stern, a longitudinal section and a plan. We have but a single straight line in an ordinary launch hull, and that is the keel. The rest are all curves of various character. These curves and the dimensions of the motive power outfit should mutually agree, or else they are likely to prove awkward when the apparatus is being put in place, and a sacrifice of some kind would be the probable consequence, which, perhaps, a very slight deviation from the lines of the model might have avoided. The hull should be substantial throughout to withstand the strain from the weight of battery and motor when in rough water. The joiner's work will include a battery receptacle or receptacles of the required dimensions. A trough placed directly over and along the keelson, with the seats arranged on top of it, has the advantage of giving the boat maximum stability, since the centre of gravity will then fall near the keel, below the water line. The passengers sitting back to back in two rows along the centre, will add to this advantage, while they at the same time may have an unobstructed view in front of them. Another method consists in placing the battery in a similar trough, laying the floor over it, and arranging the seats above this floor along the sides or across the hull. Access to the battery can be obtained in the first instance by removing the top of the seats, and in the latter through trap doors in the floor. Again, another way of distributing the cells consists in arranging the battery receptacles along the sides of the hull, with seats on top of them. A combination of the above methods may be effected to suit preferences. It is well to remember, however, that one of the advantages of the electric launch is that its stability may be made to exceed that of any other launch by a judicious distribution of the weight of the propelling apparatus.

As to the material of the hull, wood is preferable to steel or iron if it is considered that acid is to be carried on board, although by a suitable construction of the cells and receptacles leakage or spilling can be prevented under ordinary conditions.

THE MOTOR.

A good launch motor embodies high efficiency, with special compactness, low speed and reasonably light weight. These qualities are not easily to be found combined to the desired extent either in stationary or car motors.

It is usually desirable to put as large a power outfit into a boat as can be conveniently placed there and looked after, and since the battery requires the largest amount of space, the obviously most suitable place for the motor is in the stern, as far back as possible. The shape of this space then will guide us in the selection or construction of the motor. The cross section in an ordinary launch hull resembles the shape of the lower part of a heart, diminishing in width toward the sternpost. The available base area for the motor being triangular, the base must be narrow. With an armature of about double the length of its diameter and the field magnets crowded around it to suit the lines of the hull, we have a motor that can be placed without unnecessarily encroaching upon space desirable for batteries or passengers. A low armature speed (say 500 to 800 revolutions per minute) will admit of coupling the motor shaft directly on to the screw shaft without necessitating excessive fineness of pitch in the screw. We have here the ideal method of transmission. There is no lateral strain on the motor bearings, while the thrust bearing, interposed be-

tween the motor and the screw, takes up the longitudinal strain.

The conditions of load in a launch motor are analogous in the main to those of a fan motor, but more particularly to those that would be encountered in an air ship or flying machine, the following characteristics being observed:

The load consists in the resistance offered by the water to the motion of the screw. The movement of the latter is independent of its support—the boat in the present case—and its effect will be either to set in motion the medium (water) in which it moves, if the support is fixed, or to propel the latter if it is free, in consequence of the inertia of the medium. Hence the force required to start a boat is merely that required to overcome the inertia of the body of water affected by the screw proper and is independent of the inertia of the boat. The motion, being first imparted to the water, is gradually transferred from the latter to the boat, until a point of equilibrium is reached, determined by the resistance encountered. It will be seen from this that even if we throw the full load upon the motor at once (as is usually done), the difference between the starting effort and that required to maintain the final speed of the boat is so small as to be entirely negligible in the determination of the capacity of the motor. Speed once being reached, the load will remain constant on a straight run, while it will slightly increase on turning the vessel about, until a straight course is resumed. In running against a current, the load of the motor is smaller than in still water, while it is greater on running with the current. Under the conditions ordinarily met with, this difference is, however, but slight. Automatic governing devices are obviously not required; unless we were to consider an equipment for a large seagoing vessel. If it is desired to get two or more different rates of speed, the battery may be split up into a corresponding number of sections, and by means of a special switch connected in series or parallel. As to the winding of the field magnets, plain series winding is the simplest and the least liable to give trouble. The conditions enumerated above necessitate no other. The brushes should admit of reversing the direction of the armature movement, but their "lead" is best adjusted for forward motion of the boat, unless a double set of brushes is employed, with reversing lever to engage one or the other as required. A suitable switch inserted between motor and battery serves for starting, stopping and reversing the motor.

THE BATTERY.

As previously remarked, the storage battery, on account of its superior fitness, is universally employed in connection with electric launches at present. Without entering upon the details of its construction, we will consider the features to be dealt with in its application. The first question confronting us is that of bulk and weight. The manner of disposing of the battery has already been touched upon in considering the hull. Being composed of a number of small units, there need be no difficulty in distributing it. An ordinary launch hull can well carry all the *weight* corresponding to the *bulk* of battery which can conveniently be placed with due regard to accessibility. We will, for convenience, take into consideration a battery of a well-known type, designed for portable and locomotive purposes, occupying, per cell, 0.23 (solid) cubic foot of space (box, plates and all) and having a capacity of 150 ampere-hours, or about 290 watt-hours, at a discharge rate (normal) of 25 amperes or an average of about 48.32 watts; its weight being about 40 lbs. Reduced to unit cubic foot, we have: weight, about 175 lbs.; capacity, about 1260 watt-hours, with normal discharge rate of 210.1 watts per cubic foot. The displacement per cubic foot of battery will then be equivalent to ($\frac{175}{62.5}$=) 2.8 cubic feet of (pure) water; at this rate allowance for weight of battery must be made in determining the water line. With ordinary launch hulls, the average battery load that can be carried conveniently represents about one-third of the total actual displacement in tons, including passenger-load. Any smaller proportion may, of course, be applied, with correspondingly reduced results in capacity. The capacity of the battery and motor are considered mutually; for maximum effect the former guides the calculation. With the type of battery above assumed, if it is to be worked at "normal" rate, the capacity in electrical horse-power of the motor required will be equal to the number of cells multiplied by 0.0647, the working rate in elec. h p. per cell, or to the number of cubic feet of battery multiplied by 0.2816, the corresponding constant per cubic foot. For a rough preliminary calculation, on the basis that the weight of battery represents one-third of the total weight, we have,

$$\text{Capacity} = \frac{D}{3} \times 3.604 \text{ elec. h. p.}$$

where D=total displacement (weight) in tons and 3.604 the working rate of battery in elec. h. p. per ton (12.8 cub. ft). The duration, T, of the run in hours for one charge of battery will be:

$T = \frac{C}{R}$ hours, C denoting capacity of battery in watt hours and R denoting rate of delivery in watts.

Since the power required to propel a vessel varies as the cube of the speed, and since the duration of the run varies inversely as the power (rate of delivery), it follows that the *mileage* covered by one charge of battery will vary inversely as the *square* of the *speed*. In practice, due allowance is to be made for the characteristics of the motor and for a falling off in the total out-put of the battery when pushed to a high rate of delivery. Where a maximum of speed is to be effected, the battery should have a maximum of active surface and a minimum of internal resistance, to facilitate a heavy discharge without an excessive drop of potential. Special care should be taken to render the cells acid tight, by the use of suitable covers, etc. Spilling may also be avoided by preparing the electrolyte in a suitable manner. The jelly electrolyte invented by Dr. P. Schoop offers in this respect a remarkable advantage. It is also advisable to line the battery receptacle with some acid-proof material, preferably an insulator, and to provide a bed for the cells to stand on containing a substance capable of absorbing and neutralizing acid. All wires or cables employed about the boat should have a good acid and salt-waterproof insulation.

CHARGING FACILITIES.

These, or rather their absence, are a practical hindrance to a rapid introduction of electric launches. As in the early days of steam navigation, coaling stations were scarce and even wood was not everywhere available, there now exists a similar lack of suitable bases of supply for electric boats. Moreover, the supply of energy for the latter does not consist in solid matter kept in stock at a convenient place, but in a live current, to be produced on the spot at the time required, by means of comparatively complicated and expensive apparatus. It is at *this* point where compensation is exacted for the numerous advantages of the electric launch; but it is also at *this* point where the real labor attached to its operation, and where all the features of "nuisance," which are unavoidable with steam and naphtha boats, are located and concentrated. The charging plant consists of a power plant, dynamo and accessories of a capacity corresponding to that of the boat outfit. Where a continuous current incandescent lighting plant exists, current may be derived therefrom for charging purposes; suitable arrangements must, of course, be made in such cases for the proper application of the current, the E. M. F. of which may not always correspond with that of the battery. Supposing we have a launch containing 40 storage battery cells of the capacity above

assumed (150 ampere hours) and we have a 110-volt current for charging. The difference of potential required at battery terminals (cells in series) would then be $40 \times 2 = 80$ volts at the start and about $40 \times 2.5 = 100$ volts at the finish —if a constant current, 25 amperes in this case, is to be maintained. To reduce the initial E. M. F. of the circuit we must then introduce a resistance, R, of

$$R = \frac{110-80}{25} = 1.2 \text{ ohm}$$

at the start and gradually reduce the same as charging goes on to the final minimum of (approximately)

$$R = \frac{110-100}{25} = 0.4 \text{ ohm.}$$

Or, we may apply a constant E. M. F. of about 90 volts, (2.25 volts per cell) by inserting a constant resistance, R, of

$$R = \frac{110-90}{25} = 0.8 \text{ ohm,}$$

in which case we will receive a heavier current at the start, reducing itself (in consequence of the increasing counter E. M. F. of the battery) gradually to a minimum at the end, the average being the same as in the other case. The latter method may be preferable; the current will decrease in proportion to the facility with which the gases can be absorbed by the plates, while the results in time and efficiency remain practically the same and constant attention is rendered unnecessary. If a boat is to be charged, the battery of which, connected in series, requires a higher E. M. F. than that available, we merely need to split it up into two or more equal series to get within the required limit and then charge these in parallel with a proportional current, adjusted as above.

Storage batteries, suitable for launch purposes, are, as a rule, capable of receiving their charge at a higher rate and in less time than the employment of most arc light currents would involve; this is one reason why incandescent light currents (continuous, low tension) are preferable. But arc light plants are the ones most frequently met with and may often be the only source available. It should be remembered, however, that with a high tension current (say, 1,000 volts and over) an electric launch, floating in water, would not unlikely prove an inducement to "grounding."

The battery may, of course, be charged either on the boat or may be removed for that purpose. While the former method is ordinarily practised, it is obvious that in order to avoid delay, a freshly charged battery may be substituted for the exhausted one. With suitable facilities for handling the batteries, such as a hoisting crane, or equivalent device for lifting and lowering the cells into and out of the boat, tables to receive the cells for charging, suitable cell crates with connections and lifting attachments, etc., the work of exchanging the batteries could be effected promptly and efficiently for a whole fleet engaged in continuous traffic.

OPERATION.

The operation of an electric launch is the ideal of ease and simplicity. It consists, practically, of turning a switch and—letting her go. The pilot can act at the same time as engineer, for he can start, stop or reverse as easily as he may give a signal for that purpose, and need not wait for a response. Somebody, on noticing the incomparable facility with which an electric launch can be operated, suggested it was a veritable "buggy on the water." It certainly involves none of the jarring which inevitably accompanies a buggy-ride on land, and there is no need for "cheering up" or "urging" the animal. Not one of the smallest advantages is the fact that there is no danger of explosion. The most reckless handling of the propelling apparatus would entail nothing worse than its disablement, and as to danger from shock, it is unnecessary to explain its absence here. The run may be continuous or interrupted; a landing may be effected and the boat left without attendance for any desired length of time, and the journey resumed at a moment's notice. Knowing the number of miles or hours the boat can run with one charge, the man in charge will be guided thereby, as is the engineer of a steam launch by his pile of coal, and probably more definitely. The disagreeable features of steam and naphtha launches (aside from their danger of explosion), such as smoke, smell, soot, ashes, dirt, grease, heat, noise and the jerking caused by the reciprocating motion of the engine, are totally absent in the electric launch. The propelling machinery has substantially but one moving part and the motion of that is rotary, insuring smoothness, quietude and ease, and involving but a minimum of wear, while the liability to a breakdown is very remote. There is no necessity for the grimy man with dirty overalls—his place is on shore, at the charging station. The battery, besides doing its regular duty in operating the motor, can, of course, be employed at night to furnish current for interior illumination, side and signal lights, head light—a search light, if you please—or for submarine illumination.

REMARKS ON COST.

It is not the purpose of this paragraph to enumerate price lists of various sizes and sorts of hulls, batteries, motors and other paraphernalia; nor to juggle with figures in such a manner as would make it appear that among its rivals the electric launch is the cheapest at all events. On the contrary, as conspicuously as its advantages have been pointed out, be it admitted, that for same size and power, its first cost is usually greater than that of other craft. A storage battery and electric motor cannot be made or purchased at the price of an ordinary steam or naphtha engine of same power. The man who turns up the day after he has had an extended struggle in his sail boat against wind and tide on his homeward journey, thinking he may get an electric propelling outfit for his boat at about the price a new set of sails would cost him, gets disappointed. And so does he (motor manufacturers know the type) who imagines that an electric motor is all he needs to make a propeller out of his rowboat.

The cost of charging facilities—where such are not already on hand—is the weak point in the matter. It about equals that of the launch proper. Of course such a plant could be made to earn an existence by serving as an electric light plant at the same time, and thereby reduce the expense chargeable to the boat to a very reasonable item. But to get the two birds together is more difficult than to kill them. Where a fleet of electric launches is operated, however, the pro rata cost of plant and expense of operation can be brought within very reasonable limits. Instead of having an engineer for each boat (as in the steam launch), one station engineer can render equivalent service for a number of boats. The fuel item for one station engine need not exceed, and may be even smaller than, the aggregate consumption of several small engines (on steam launches), even allowing for the loss in conversion. The actual running expense would thus compare favorably with that of steam launches. There is another feature which should not be overlooked. In an electric boat, as pointed out before, the propelling apparatus occupies space which would be of little or no use for passengers, while in steam or naptha boats from one-third to one-half of the entire space is devoted to the machinery, and the best part of the boat at that, crowding out a proportional number of passengers. For a given number of passengers, therefore, the electric launch would be smaller, require less power, and consequently would cost less to run. Under such conditions, it would hold its own even on the point of expense, taken all in all.

In conclusion, a few suggestions as to

FUTURE ASPECTS.

While hitherto the electric launch has been confined mainly to a service of pleasure and recreation, it can-

not be doubted that where conditions are favorable, it would lend itself to regular passenger traffic with a satisfactory degree of efficiency, embodying, as it does, features well adapted to gain popularity. It would then bear a relation to large steamers, similar to that existing between the street car and the steam railroad, affording a means of communication over comparatively *short distances* in *small units*, at *frequent intervals*, taking up and landing passengers at points along the line; "feeding" railroad and through-steamer lines from points not touched by either; maintain traffic on small rivers and shallow waters not navigable by large vessels. Its readiness, whenever required at short notice, commends it to institutions and individuals located on shores or islands not otherwise supplied with convenient means of communication. It has been suggested as eminently adapted for harbor police service; its easy, quiet, and yet swift motion, the absence of visible or audible accompaniments to betray its approach, and the facility of suddenly flashing a dazzling beam of light when needed, would seem to render admirable assistance in the pursuance of river pirates or smugglers by night. Supplied with a force-pump, to be operated from the same source (battery) as its propeller, it would afford a safeguard as a floating fire engine for the water-front and vessels lying in the harbor, ever ready for immediate use, without the constant attention and maintenance expense inevitable with steam fire-boats. That the electric launch may find a field in the navy is indicated by the fact that the Italian government has attached one to a man-of-war. Other fields of employment might be suggested, but the foregoing will suffice to show the variety of uses it may and probably will be put to with advantage.

Thus far we have considered the use of storage batteries in connection with launches to the exclusion of any other electrical means. At the beginning of this article the present inferiority of primary batteries has been pointed out. It is needless to say that should the latter be brought to a state of efficiency and economy offering sufficient advantages over the former they would take the field. Instead of charging stations in the sense implied above, we would then substitute supply stations for chemicals or materials, or such other facilities as would be required for recharging, renewing, or regenerating the exhausted batteries.

There is a possibility also for a "direct" method of current supply on rivers or canals, employing conductors run overhead, or along the banks, on poles or other supports, although this plan would seem, in the light of present circumstances, to offer little more inducement than one involving the propulsion of road wagons or stages on a trackless road by an overhead method. Under exceptional conditions, however, such as for instance would be encountered in a very rapidly flowing river, a powerful floating motor, operated from an exterior source of current, undoubtedly could accomplish what might be impossible with any self-contained propeller. As for canal boats, it would be a difficult matter to combat the mule on the score of economy, while increased speed is not favored on account of the damage to the banks caused by the swell; for whatever sort of propeller may be devised to reduce the wash occasioned thereby (and who has not heard of the various arrangements designed to avoid it?), we cannot move a floating body, such as a boat, through water, without displacing, and consequently disturbing, the latter, to an extent proportional to the velocity of the boat.

The problem of producing electricity from heat direct to compete with steam, if brought to a successful issue, would probably affect navigation as much as any other field. Although the electric pleasure launch, to be devoid of the features accompanying the combustion of fuel, would even then carry its battery on board, an immense field would await the new generator in the larger vessels of commerce and—in conjunction with gigantic electric motors—even in the great ocean racers of the future.

In compliance with the request of the editors of THE ELECTRICAL ENGINEER, I give below an

ESTIMATE OF COST

of a fleet of 12 electric launches, each 28 feet long, 6 feet beam, carrying one ton of storage batteries, to run 6 miles per hour for 60 miles with one charge:

12 hulls complete, with interior fittings (battery troughs, seats and lockers), fixed roofs, shades, flag staffs, steering wheels, etc.,	$6,600
12 tons storage batteries (cap. 16,240 watt hrs. per ton) at $560 per ton,	6,720
12 motors, at $400,	4,800
12 screw propellers, shafts, couplings, thrust bearings and stuffing boxes,	1,200
Switches, wires, incand. lamps (4 per boat), with fittings,	480
Acid and labor of placing elec. outfit	1,200
Seat cushions, ropes, boat hooks, tools, pumps, etc.,	300
Total, 12 boats complete, in running order,	$21,300
or $1,775 each.	

CHARGING STATIONS.

Land and buildings (on suburb. water front) say,	$4,000
Steam plant, 60 h. p. complete, erected,	4,000
Dynamo, cap. 40,000 watts, with accessories, erected,	2,000
Charging circuits and appliances, erected,	250
Mooring facilities, tools, etc.,	500
Total cost of station, say,	$10,750
Grand total cost of 12 launches with charging facilities and real estate	32,050

ESTIMATED COST OF OPERATION.

It is assumed that each of the 12 launches makes a daily run of 60 miles, divided into 6 trips of 10 miles each (3 round trips) during 5 *months* in the year:

12 pilots at $2.50 per day each, for 5 months,	$4,500.00
1 station engineer, at $3 per day for 5 months,	450.00
1 station fireman at $2 per day for 5 months,	300.00
1 station laborer at $1.75 per day for 5 months,	262.50
Coal (4 lbs. per h. p. hour, 60 h. p. for 7 hrs. daily), 112½ tons (for 5 months) at $4 per ton,	450.00
Oil, waste, miscell. supplies and incidentals for 5 months, say,	200.00
Labor, etc., putting boats in running order at beginning and storing same at end of season, say,	360.00
Depreciation, per annum, on boats and propelling apparatus, at 10% on $21,300,	2,130.00
Depreciation of station machinery and appliances, at 6% per annum on $4,750,	285.00
Interest, per annum, at 6%, on interest of $32,050,	1,923.00
Total operat. expense, deprec'n and interest,	$10,860.50
or $905.04 per boat per annum.	
Total mileage run per boat per month (60 per day),	1,800 miles.
Total mileage run per boat in 5 months,	9,000 "
Total mileage run, 12 boats, at 9,000 miles each,	108,000 "

Cost of operation, including running expenses, depreciation and interest, as per above estimate, = $10\frac{6}{100}$ cents per boat mile. The boats assumed can seat 20 passengers and over. If an average of only *one-half* of this number is constantly carried, paying fare at the rate of *one cent per mile* each, the receipts will equal the operating expense, depreciation and interest on investment, as above.

The boats, in this instance, run at intervals of about 17 or 18 minutes (allowing for short stops), $1\frac{5}{8}$ miles apart, along the entire distance of 10 miles.

The cost and operating expense of electric launches will, of course, vary with different sizes and speeds, which the conditions and requirements of each distinct case contribute to determine.

BOGART'S NEW BURGLAR ALARM AND GAS LIGHTING APPARATUS.

NOTWITHSTANDING the vast amount of ingenuity displayed in the construction of devices intended to guard the premises of the householder, improvements are steadily going on in order to make assurance doubly sure and to forestall all possible conditions of unfaithfulness on the part of servants. Among the recent developments in this direction we may note the new combination burglar alarm annunciator of Mr. A. L. Bogart, of this city, which possesses a number of novel features not heretofore introduced in this class of apparatus.

The instrument, which is illustrated in the accompanying engraving, Fig. 1, is contained in a tastefully designed

FIG. 1.—BOGART'S IMPROVED BURGLAR ALARM.

case of fine finish and workmanship, the wood being chosen to match that of the apartment in which it is to be placed.

Besides being provided with all of the arrangements common to the most modern apparatus of its class, it includes a number of devices peculiar to itself. Thus, by pressing the "silent test" knob before retiring, the instrument indicates silently whether all of the doors and windows have been properly secured. It may be set to give an alarm only during the period that a door or window remains open, or to continuously ring the bell until the main switch is turned off.

An accurate regulator time piece is enclosed in the same case, which may be set to awaken the servant in the morning at any prescribed time. Heretofore an effort has been made to produce an extremely short contact in the clock, so as to limit the time during which the servant's bell shall ring, to from ten to twenty seconds. Owing to the lost motion which occurs even in the best make of clocks, such a short contact is liable to fail entirely. To obviate this

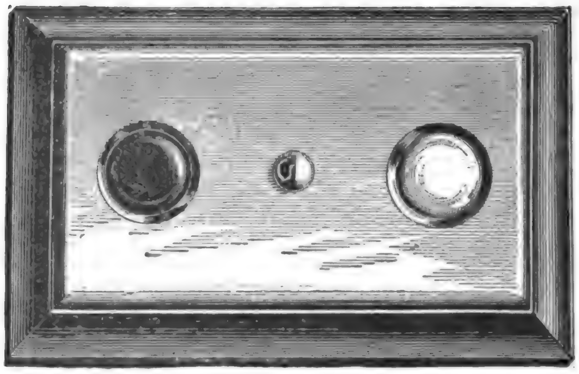


FIG. 2.—THE BARTHOLDI GAS LIGHTING PUSH BUTTON.

defect a long contact was usually made in the clock, but a switch was provided in the servant's room by which she could break the circuit on arising and thus cause the bell to cease ringing. The difficulty in this case consists in the fact that she either forgets to turn on her switch at night, or intentionally leaves it off.

In the Bogart burglar alarm both of these disadvantages are avoided by making a positive contact in the clock for at least five minutes. Under the alarm bell in the servant's

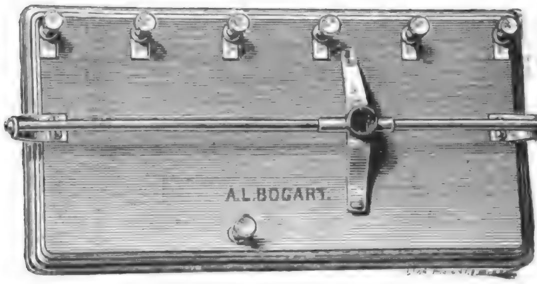


FIG. 7.—NEW MULTIPLE GAS LIGHTING SWITCH.

room is placed a push-button. When the bell sounds it is only necessary to press upon the button, when the clock switch on the face of the annunciator is automatically turned, cutting or opening the circuit to the bell. No pressure upon this button can affect the instrument in any manner, excepting only during the time that the bell is sounding.

By the act of pushing the button the servant also disconnects all such parts of the house as it is intended she shall have access to, from the burglar alarm, leaving the other apartments still connected. Unless she arises at the sounding of her alarm or waking bell, and pushes the button, the whole house remains connected and protected by the apparatus. The position of the clock switch will show in the morning whether she has arisen or not.

A special switch is provided, by which any number of automatic electric gas burners will be ignited should any of the doors or windows of the house be opened. Outside of the fact that in this instrument there is no limit to the number of automatic gas burners which can be practically simultaneously ignited in a house at the operation of the alarm, it varies from the usual forms in automatically cutting the current off from the burners as fast as lighted, thus preventing the possibility of the battery becoming run down through leaving it in circuit.

Another novelty consists in the method of giving the family admission to the house at night without sounding the alarm. At the front door is placed a small Yale-lock switch. By placing a key in the same, giving it a quarter

turn and removing it, a small clock movement in the annunciator case is electrically put into motion, which first disconnects the front door circuit and holds it open for a length of time amply sufficient for the party to unlock, open and close the front door after entering, when it again automatically closes the circuit restoring the alarm to its original condition.

Where electric gas lighting apparatus is installed in the house, a battery protector is included at the lower part of the case, as shown, which guards the gas lighting battery against accidental short-circuiting by disconnecting from the battery any circuit so grounded or short-circuited for more than the proper length of time.

The push-keys which have been ordinarily employed in connection with automatic electric gas lighting burners have proven one of the greatest annoyances to fitters in installing the apparatus, due to the fact that the connections are all in the rear, and, as a consequence, in connecting the three wires thereto, but one hand could be employed to place the wires in position and screw the washers down thereon, the other hand being employed in holding the button case. This inconvenience is greatly aggravated by the position in which the case must be held, particularly where the key is to be attached to a dead wall and the wires are consequently very short. Again, in such cases it is impossible to inspect the connections should any fault occur, without taking down the whole key, which causes the screw holes in the wall or plaster to break away and become mutilated about the key case.

Mr. Bogart has also designed a new form of button to overcome these disadvantages, and known as the "Bartholdi." Fig. 2 shows this key in perspective. It consists of a polished wooden base with a polished bronze, or brass, or nickel-plated cover having two buttons, one white and the other black, the cover being held in place by a single screw. Fig. 3 represents the base with the cover removed; the latter is shown reversed in Fig. 4. The connections, as will be seen, are all attached to the upper part of the base, which is attached to the wall and connections are made as with an ordinary push button. The springs on the cover hold the buttons in place and prevent them from falling out when it is being attached to the base. The cover may at any time be removed for inspection of the connections and contacts, which latter are supplied with platinum, without any necessity arising of removing the base from the wall.

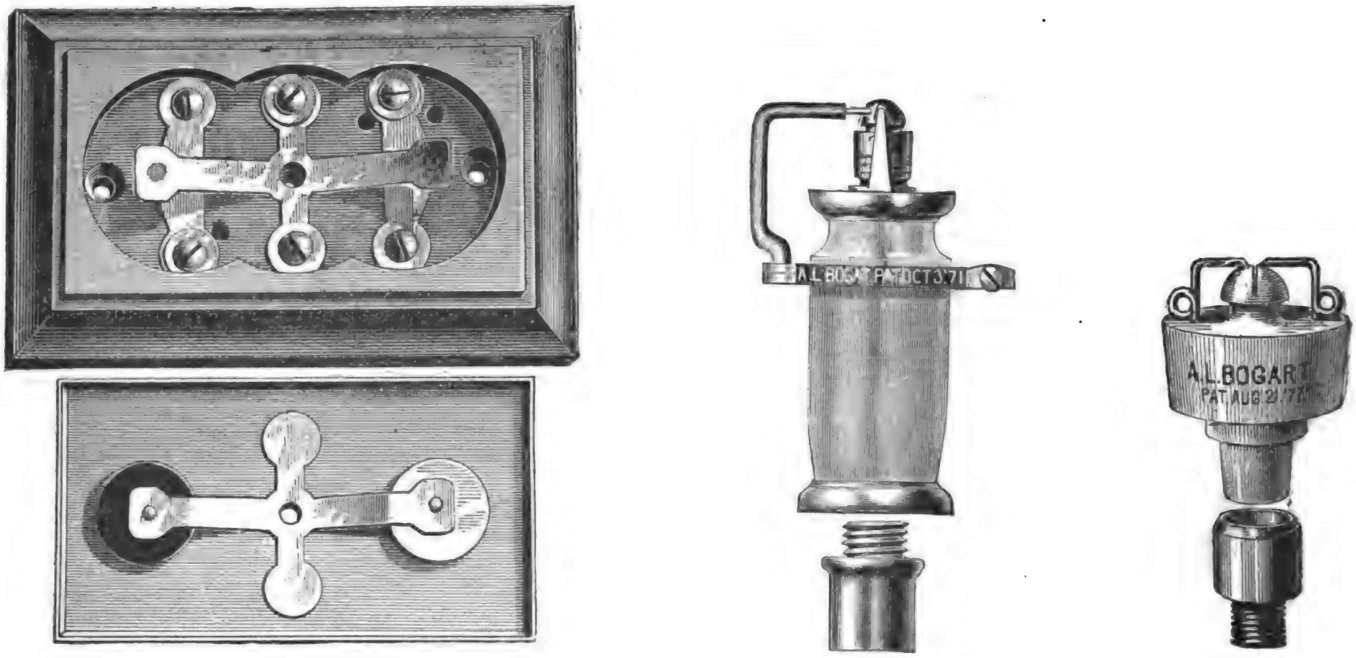
Mr. Bogart has also made some recent improvements in what is known as "multiple" electric gas lighting apparatus; that is, that class in which a series of gas burners are ignited simultaneously by means of a current of high electromotive force produced by either a static generator or induction coil.

An improvement in what is known as the "porcelain burner" is shown in Fig. 5. As originally constructed one of the spark electrodes was made a part of the tip, and as a consequence, a special tip had to be employed in case of repairs or alterations of size of the same. As will be seen, in the present form the tip electrode is independent, being constructed of a peculiarly formed piece of metal, which is held in position by the iron tip being screwed down upon it. It is readily adjusted in position; from its size and material it withstands the action of the flame, and any form of metal tip can be substituted for the original one, should a change be desirable.

Fig. 6 represents a new construction of "multiple" burner, where the flame is required to be at a lesser distance from the gas-pipe than would be permissible with the porcelain burner described above. The upper portion represents the burner with its electrodes, the material used as the insulator being entirely of steatite or lava. It terminates at the base with a taper nozzle which will fit into any ordinary burner pillar after the removal of the common lava tip. In case the gas fixture upon which the burners are to be used is supplied simply with iron tips or tip sockets, as in the case of reflector rings, then the metal socket shown below the burner is employed, it being provided with a quarter-inch (brass) thread. Fifty of these burners may be lighted in one series. In case a still shorter burner is required, the taper nozzle at the base of the burner may be removed, leaving a screw thread cut in the lava itself, for attachment to the fixture.

These burners are particularly adapted for use within imitation candle burners, the diameter being so small as to readily pass within the ordinary porcelain shell.

We also illustrate, in Fig. 7, a new form of multiple lighting switch, designed by Mr. Bogart, in cases where a number of series are to be lighted. The switch point slides horizontally, and thus makes the connection of the circuit wires more convenient than where the switch lever revolves, and the latter cannot slip out of position, remaining wherever placed.



Figs. 3, 4, 5 and 6.—Bartholdi Gas Lighting Push Button, and New Multiple Burners.

ELECTRIC RAILWAYS AND OCEAN CABLES.

BY T. D. LOCKWOOD.

I HAVE read with a good deal of interest the communication of Mr. Cuttriss, in THE ELECTRICAL ENGINEER of August 6, concerning the disturbances manifested in his cable receiving instruments, which he attributes to the operation of an electric street railway at a distance of upwards of half a mile therefrom; and with equal interest the editorial comment on said article.

Though it is doubtless often unpleasant to be like Mr. Cuttriss and myself on the physically weaker side of a controversy, that position is not without its offsetting advantages, in that we are forced to study, and let us hope sometimes to master, the problems they involve; while persons working with less delicate appliances and with the electrical pursuits which cause, as distinguished from those which suffer from, the disturbances, are often and naturally content with a perfunctory examination of the matter.

As I have read the two articles, I gather that the disturbed cable circuit comes into the station from the sea conductor, passes through the instruments at the said station and then back by way of a closely parallel insulated conductor in the same cable to earth at the cable armor.

If I have correctly interpreted the arrangement, it is first to be observed that it is not as stated in the editorial comment "a complete metallic circuit," but simply a loop of an earth completed circuit, the two wires of said loop being parallel.

I should scarcely expect that any such disturbances as are described arise from magnetic induction, and in the light of experience do not believe they do, not so much, however, because the wires are looped for a certain distance, as from the fact that in addition to said looping, they are buried; they are underground; both conditions would tend I think to adversely affect magnetic induction.

I am inclined to believe that the disturbances have a twofold cause; that they are partly due, as Mr. Cuttriss suggests, to actual conduction through the intervening earth and water from the earth side of the electric railway circuit to the cable armor, and thence by way of that conductor, which is grounded on the armor, and through the instruments to the cable main conductor; and also in part attributable to the actions and reactions of electrostatic induction, which in such a case are likely to be complicated.

We may consider the earth, if of favorable constitution, to be heavily charged by the electricity poured into it from the cars.

It is not difficult to conceive that such a charge in the medium surrounding the buried cable will tend to attract a like charge of opposing sign, through the dielectric on both conductors of the cable. Thus if the earth be charged to a given plus potential by the railway, the two parallel conductors of the cable loop will both be the recipients of a minus charge. But this charge must come from somewhere, and as the armor earth terminal is nearer than any other, the major part of it comes from that point. But there is another reaction; the two sides of the loop are of unequal length, and it may well be imagined that the charge on the short side, that grounded on the cable armor is thicker, if I may so express it, than is that on the long leg which is but the end of the main cable conductor. The two will tend to react on each other, and the amount of the perceptible reaction will be the difference of the two charges.

But of course, any change in the potential or degree of charge in the surrounding earth, will eventuate in a redistribution, and a rearrangement of the charge in the cable; and such a rearrangement amounts virtually to a circulation of current. And as all changes or transfers of electricity from one side of the loop to the other must pass through the instrument, we necessarily have the undesired operation of the said instrument.

The editorial says: "There will, of course, be a solution for the difficulty, but it will be interesting to see just what it is." The solution of the difficulty is, in my opinion simply the use by either party of the complete parallel wire metallic circuit, imperfectly and at a high cost, by the cable company, whose property is trespassed upon; or in a practically perfect way, at a comparatively low cost, by the railway company, who is doing the tresspassing.

POWER TRANSMISSION IN FRANCE.

AT the recent meeting of the Société Internationale des Electriciens M. Hillairet described the interesting transmission of power by electricity which has been carried out near the town of Doméne in Isère, France. In this installation power equal to 200 h. p. delivered is transmitted to a paper mill at a distance of $3\frac{1}{4}$ miles from the waterfall utilized. Lantern slides from photographs taken last winter were shown giving different views of this installation from the waterfall and works passing along to the motor, with all the accessories necessary for the transmission. An interesting feature of the installation is that during the winter the little generating works is entirely cut off by the snows for two months from the paper mill where the force is utilized, but nevertheless continues to work regularly. The telephone enables it to be known whether all is going well, and keeps up communication with the inhabitants of the valley.

DISCHARGE THROUGH A LIGHTNING ARRESTER.

THE following description of a lightning stroke has been sent to the *Victorian Telegraphic Journal* by Mr. James M'Carter, of Melbourne:—"Recently during thunder and lightning, without rain, I 'cut out,' and shortly afterwards was shocked by seeing the office apparently ablaze, and hearing a terrific report, similar to that of a gun, but much louder. I fully expected to find the whole front of the office smashed in, and could hardly credit, on examination, that the only damage done was several of the screw points of the arrester fused. The point of one screw was flattened on to the centre plate, resembling a small coin. I scraped this off, and found there was an indent on the earth plate."

SOME DETAILS OF THE PERAL SUB-MARINE BOATS.

The Peral electric sub-marine torpedo boat is of the usual cigar shape, and is provided with four screws, two vertical ones for effecting immersion and two for purposes of propulsion. The screws are driven by Immisch motors energized by Julien accumulators. If any accident occurs to the motors and the immersion screws are stopped, the boat rises at once to the surface without further aid, though, of course, the emptying of the water compartments hastens the ascension. To avoid an undue expenditure of power in connection with the immersion screws, the water compartments are filled to an amount which enables a very slight motion of the screws to sink the boat to the required depth and maintain it there. The automatic apparatus which regulates the depth at which the boat is to work is designed on a principle somewhat similar to that of the aneroid barometer. A curved tube of elliptical section is placed in connection with the sea, and its deformations due to the alterations of pressure actuate a switch, by which the strength of the current going to the immersion screws is varied. The positions of the contacts of the switch are altered to suit the particular depth at which it is required to work. A very sensitive automatic electrical device is also employed to keep the vessel in a horizontal position. The apparatus consists of a pendulum playing between two contacts. If the boat is not perfectly level from stem to stern, the pendulum touches one of the two contacts, and the result is that the corresponding vertical screw is actuated and the boat is righted. The speed which the inventor hoped to realize, namely, ten miles an hour, has been much exceeded.

THE BROOKLYN INSTITUTE'S ELECTRICAL LECTURES.

The Executive Committee of the Department of Electricity of the Brooklyn Institute is now planning the work for the coming year on a very practical and extensive scale. For the lecture course they have arranged for 24 lectures to be given by leading electricians and electrical engineers who have the faculty of speaking before an audience. Sixteen of the 24 have already been secured by Prof. F. W. Hooper, who is now making arrangements for the rest.

THE WORKING EFFICIENCY OF SECONDARY CELLS.[1]

BY W. E. AYRTON; C. G. LAMB, E. W. SMITH AND M. W. WOODS, ASSOCIATES.

SINCE 1881, when the formation of Plauté storage cells was greatly accelerated by Faure's device of pasting the plates, numerous tests have been made in different parts of the world on the capacity and efficiency of secondary cells. The first tests that were carried out were conducted simultaneously, at the end of 1881, in England by Prof. Perry and in France by a committee consisting of Messrs. Tresca, Potier, Joubert and Allard.

The "resuscitating power" made it very difficult to say when a cell was discharged completely, and the beginning and end of a test was indeterminate.

In the author's method the cells were "emptied" until the discharge was barely perceptible; then they were short-circuited with a short, thick wire, being at the time insulated, and thoroughly discharged for three successive days and allowed to recuperate in the two intervening nights.

The efficiency obtained by this treatment was not less than 82 per cent., and naturally much more than could be obtained in practice, as the point to which the E. M. F. might profitably be allowed to fall is far above the comparative exhaustion recorded. Still, it was reliable in the sense that all the energy put into the cells reappeared without any reinforcing from unexpended energy formerly put into the cells, but the resuscitating power had ample chance for its operation.

The French commission considered the cells discharged when a current that was produced through a specific resistance could no longer be kept up. Provided the cells had undergone a thorough discharging before trial, this method seems to be as accurate as need be, but no evidence of this occurring appears in the report, and it is not impossible that the cells were drawing upon a store of energy put into them on previous trials and giving a higher value than the working efficiency; and a very possible neglect of the powerful resuscitating power of accumulators may have vitiated some of the published results of experiments that have been made on them. This doubt must not be forgotten in considering the accompanying list, which is as complete as it has been able to make it, of all such experiments that have been made up to date. At the middle of 1889, when the author's investigation had been nearly completed, there appeared two very important contributions to the subject—one on "The Inherent Defects of Secondary Batteries," by Dr. Louis Duncan and H. Wiegand; the other, "Ergebnisse von Versuchen an Akkumulatoren für Stationsbetrieb," by Prof. W. Kohlrausch and C. Heim.

Kohlrausch and Heim lay great stress on the fact the discharge of accumulators depends not only on previous discharge but also on the previous history of the cells.

At the inception of Prof. Ayrton's test the question arose whether to maintain a constant resistance of circuit or to vary it, as the E. M. F. fell, in ratio to maintain a constant current. The latter method was adopted, and, in order to dispense with manual intervention and the constant personal attention of an observer to start the charging directly upon the conventional discharge ceasing and eliminate any chance of error as to duration of the experiment, an automatic arrangement was employed which maintained a current more uniform than the most adroit hand-regulation, and broke the circuit between charging, discharging and vice versa, when the P. D. touched the predetermined limit.

There is a popular faith in certain checks upon the foregoing process, such as the variation of specific gravity of the solution, which was found to vary directly with the duration of a constant current, amounting to about .002 per hour, a coefficient without the scope of any average hydrometer and useless in itself as a method of precision. The sudden plunge in the diagram of potential near the termination of a discharge is a very potent factor in the summation. The feature of "gassing" only amounts to a rough test, is not applicable to discharge, and may fairly be neglected in estimating efficiency and energy.

A number of experiments were made on two of the cells in order that the *exact* shape of the curves of P.D. at the *end* of the charge and discharge might be ascertained. The curve shown in Fig. 1 is the end of the P.D. curve for one cell on charging with 9 amperes for 14 hours; from which it is seen that the rate of variation of the P. D. with time is greatest when the P.D. is about 2.36 volts, indicated by the point A. In Fig. 2 is shown the curve of P.D. during the last 3½ hours of a discharge with 10 amperes, the discharge being continued for 12 hours. In this particular experiment the discharge was allowed to continue until the P.D. fell to 1.365 volts, indicated by the point C, which is far lower than the P.D. was allowed to fall on any other occasion. At about 1.8 volts the P.D. curve begins to fall pretty rapidly, and the slope of the curve, or the rate of diminution of the P.D. with time, goes on increasing until the P.D. has fallen to 1.6 volts, indicated by the

EFFICIENCY TESTS OF ACCUMULATORS.

Date.	Maker of Cell.	Experimenters.	Efficiency. Quantity.	Efficiency. Energy.	Remarks.
1882	Faure	Ayrton and Perry	..	82	Cells short-circuited for some time before being tested. Cells discharged on three successive days, and allowed to recuperate during the two intervening nights.
1882	Faure	French Commission	92	70	Result of a week's work. Current kept fairly constant during discharge by the addition from time to time of fresh cells.
1883	Shultz	Hallwachs	..	6 to 50	Results variable and indefinite.
1883	E. P. S.	H. Morton	90	..	
1883		Aron	..	6 to 50	Results very variable.
1885	B. T. K.	Forbes	80	69	Mean of one week's work. Current not kept constant.
1886	Farbaky and Schenek	Waltenhofen	91.7	78.7	
1886	E. P. S.	Drake and Gorham	90	80	Current maintained constant during charge and during discharge.
1887		Haebelin	92	..	"Cells not good."
1887	Fitzgerald	Lea	91	..	
1887		Huber	..	88	
1887	C. Smith	Miller	80	..	Lead spirals painted over with salts.
1888	Huber	W. Kohlrausch	90.7	78.4	
1889	Farbaky and Schenek	Waltenhofen	88.1	77.4	
1889	Tudor	W. Kohlrausch & Heim.	94	82.4	Normal currents used in charging and in discharging.
1889	"	" "	77	64.7	Charging and discharging currents rather more than twice the normal.
1889	"	" "	81.4	71.7	Cells allowed to rest for 160 hours after charging.
1889	"	" "	90	80	Cells first completely discharged by the external resistance being gradually diminished to nought.
					The positive plates of these Tudor cells are first formed by Planté's process, then the holes in the grids are filled with minium, and the forming continued. The negative grids are not formed at all, but merely have the holes in the grids filled with lead oxide.

1. Abstract of a paper read before the Institution of Electrical Engineers at Edinburgh, July 16, 1890.

point A on the curve in Fig. 2. Here $\frac{dV}{dt}$ per cell has reached a value 1.4 V being measured in volts and t in hours. Below this the curve has a shape that has not hitherto been noticed, for when the P.D. per cell has reached 1.556 volts, indicated by the point B, the curve suddenly alters its shape, becoming the straight line B C, with a less inclination to the axis of time, $\frac{dV}{dt}$ being for this line only 0.44.

Just as in the curve in Fig. 2 the discharge has been continued much below the usual limit, so what would take place if the charging was also prolonged much beyond the usual limit was examined. Fig. 3 shows the rise of the P.D. when the charging at 4.52 amperes was continued for 37¼ hours, 25¼ hours being sufficient to fully charge the cells with this constant current of 4.52 amperes—that is, to charge them until the P.D. per cell was 2.4 volts. It will be observed that whereas the volts rise from 2.25 to 2.38 between 23.1 and 25.5 hours—that is, 0.13 volt per cell in 2.4 hours—the rise in the following 12.3 hours is only from 2.38 to 2.55 volts, this is, only 0.17 volt. The continuation of the curve shows the drop of P.D. on breaking the charging circuit: there is an instantaneous fall of 0.28 volt per cell, and a further fall of 0.1 volt in the E. M. F. in two hours.

The curve in Fig. 4 shows on a larger scale this drop on breaking the charging circuit when the cells are very well charged,

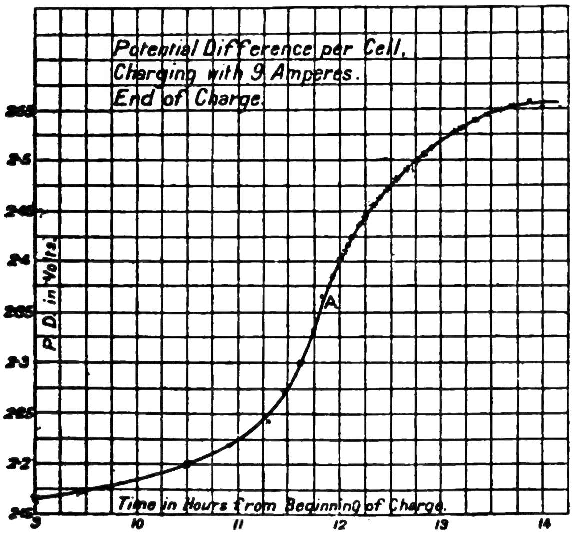


Fig. 1.

leaving it broken for five minutes, and then closing it again; the charging current in this experiment being 9 amperes. There is, as will be seen, a nearly instantaneous drop of the terminal P.D. per cell from 2.56 to 2.31, then a steady fall in the E.M.F. from 2.31 to 2.24 volts in five minutes. On reclosing the charging circuit at this moment, there is an instantaneous rise of the P.D. to 2.48 volts, and then a slow rise to 2.56 volts in five minutes; so that after reclosing the charging circuit it took, in this experiment, the same time for the P.D. to recover the value it had just before breaking as the time during which the circuit remained broken.

Experiments were also made on the time rise of the E.M.F. on stopping the discharge. Later on, however, the time rise of the E.M.F. on breaking the discharge circuit, as well as the time fall of the E.M.F. on breaking the charging circuit, for various currents, was measured in a far more sensitive way than in the early part of the investigation.

On starting a discharge the P.D. generally falls slightly to the value that is maintained fairly constantly during a long portion of a discharge. After a prolonged rest, however, it was found that the P.D., on the contrary, shows a *decided rise* at the commencement of a discharge, and that it is not until the third discharge takes place that the curve resumes its normal character with the slight drop in the value of the P.D. at the commencement of the discharge.

EFFICIENCY.

In the earlier experiments made on the quality of efficiency great care was taken as to the accuracy of the instruments used; special calibration of them was made previous to, and at the conclusion of, the experiments.

The coarse adjustment of the resistance for keeping the current constant was effected by means of resistance coils made of bare German silver wire suitable for standing large currents; the fine adjustment was performed by means of horizontal mercury troughs through which the current passed, the lengths of the mercury in the wooden troughs through which the current passed being varied by copper bridge-pieces. The mercury trough arrangement forms an extremely convenient resistance for delicate adjustment by hand. To keep the current as constant as possible a dynamo was not used to charge the accumulators under test, but they were charged instead from other accumulators of much greater storage capacity.

The problem of keeping the surface of the mercury clean solved itself after the failure of all supposed remedies. Alcohol dried up, water electrolyzed, oil carbonized and long spiculae grew upon each platinum point until the auxiliary accumulators referred to later were short-circuited. By being left entirely alone, a thickish layer of mercury and mercurous oxide formed on top, through which the platinum points easily penetrated and made perfect contact.

Some practical limitations to the refinements of laboratory experiments are significantly accented by the appended tables:

Group of 10 *Cells—No. I.*

Discharge at 9.933 Amperes.		Charge at 9.05 Amperes.		Percentage.	
Ampere-Hours.	Watt-Hours.	Ampere-Hours.	Watt-Hours.	Quantity Efficiency.	Energy Efficiency.
119	2,280	114	2,435	105	94
105	2,045	102	2,220	103	92
101	1,970	101	2,220	100	87
104	2,020	104	2,270	100	89
Discharge at 9.933 Amperes.		Charge at 4.519 Amperes.			
112.5	2,170	115	2,485	98	87
113	2,190	115	2,485	98	88

Group of 10 *Cells—No. II.*

Discharge at 4.858 Amperes.		Charge at 9.104 Amperes.		Percentage.	
Ampere-Hours.	Watt-Hours.	Ampere-Hours.	Watt-Hours.	Quantity Efficiency.	Energy Efficiency.
154.5	3,005	138.5	2,910	111.5	103
141.5	2,770	129.7	2,820	109	98
Discharge at 4.858 Amperes,		Charge at 4.519 Amperes.			
143	2,785	141	3,075	102	90.5

Now not only are quantity efficiencies of 105, 103, 111, 109, etc., per cent. impossible, but energy efficiencies of 94, 92 per cent. are also too high, when accumulators are being charged and discharged at the maximum rate allowed by the manufacturers. Further, it is noticeable that for each set of tests both the quantity and energy efficiencies diminish on the whole as the tests proceed. These cells, like the other cells in the Central Institution laboratories, have been charged at regular times; and as the number of ampere-hours taken out of them for ordinary laboratory work varies very much, the intervals between the periodic chargings are so arranged that, on the whole, the cells are charged up much more than they are discharged.

Hence at the commencement of these tests the cells had a large store of energy in them on which to draw in the discharges, the results of which are given in the preceding table. From this we learn this very important fact—that *if accumulators be thoroughly well charged up before being tested, then five days' continuous charging and discharging alternately with even the maximum currents allowed by the manufacturers fails to give the normal quantity, or energy, efficiency.*

It will be noticed that both the ampere-hours and the watt-hours are increased by diminishing the current employed. This is partly due to the fact that if a fixed P.D. limit per cell be employed either in discharging or charging, the cell is discharged until the E.M.F. is slightly lower, and charged until the E.M.F. is slightly higher for a small current than for a larger one.

The following special appliance was used to regulate the current. An independent current for the sole purpose of working the current regulator finds its way through a platinoid strip of sufficient section and surface to entail 110 appreciable change of resistance to the 10 ampere current following through it. A permanent magneto-electric machine turns a brass roller in either direction, with angular velocity, no greater than $\frac{1}{300}$ that of the magneto's armature. The roller is electrically divided and turns with a minimum friction in its journal. Platinoid wires, uninsulated,

envelop each half of the roller, their lower ends soldered to the rollers and upper ends to a brass bar balanced through suspension over pulleys.

A current entering the roller axis finds its way through one-half roller up to the swing-bar, down to the opposite half roller and to the bearing opposite to that by which it entered. Thence it passes to a solenoid, whose deli ately hung core is confined solely to axial motion by the use of two strings at each end, the upper ends of each couple spread apart, and the lower ends uniting at a common point of suspension at an extremity of the core. The core communicates with a platinoid spiral spring which required a certain period of use to arrive at a constant coefficient of elasticity, and its precision is remarkable.

The charging current from an outside battery finds its way through the platinized strip, the swinging brass roller, the solenoid and back to the battery to the opposite pole. If this current exceeds the predicated limit, the solenoid plunger makes a contact which by revolution of the brass roller increases the resistance in its circuit, or in the opposite contingency, by contrary motion, decreases it. The deviation for days at a time does not exceed $\frac{1}{100}$.

It was very interesting to watch the regulator, as the armature of the motor was almost always in motion, now making half a turn one way and then a full one the other. One turn of the armature shortens or lengthens the platinoid wires about 0.16 inch, or one three-thousandth of its own entire length.

What effect rest has upon accumulators was demonstrated by five periods of inaction; the average of the five being fourteen days. They showed a reduction of 26 per cent. in quantity and the same in energy, confirming Kohlrausch in his view that

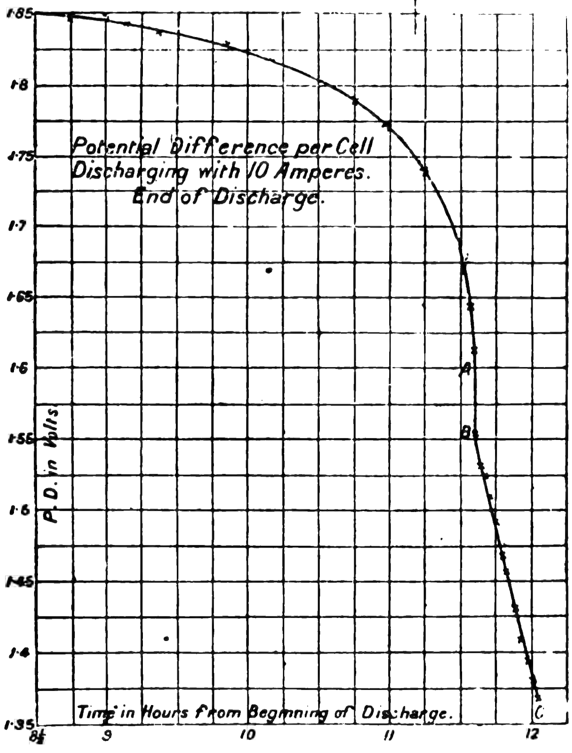


FIG. 2.

previous history has everything to do with a cell's efficiency. The fact of the P. D. rising during the first hour of discharge proves their abnormal character.

Dr. Frankland has shown that an accumulator discharge evolves the special lead salts (which are formulated as $Pb_3 S_2 O_{10}$. and $Pb_5 S_3 O_{14}$.) on account of the difficulty of electrolytically decomposing white sulphate of lead. It appears from the tests that the rise of temperature of the cell during charging may, after allowing for changes of temperature of the room, be either about 1.3° C. or 0.77° C., while the fall of temperature during discharging may have either of the two preceding values. It is further interesting to notice that the rise of temperature during the charging has the higher or the lower of these two values according as the fall of temperature during the previous discharge had the higher or the lower value.

About a year later another set of *continuous* temperature observations was made for many days and nights with the same cells, the current in discharging and charging being, as before, 10 and 9 amperes respectively. The higher P.D. limit was, as before, 2.4 volts per cell, but the discharge was in each case in this second set of continuous discharges and charges stopped at 1.9 instead of 1.8 volts per cell. As the regulation of the current day and night was in these later experiments in 1890 effected by hand, it was not kept quite as constant as when the automatic regulator was employed. Hence the time curves for the excess temperature in discharging and charging, when plotted, were not found to be as regular as in the previous case.

It was observed that in these experiments not merely does the excess of the temperature of the working cell over that of the idle cell fall during the discharge, but it actually continued to fall at the commencement of the charge.

Allusion is made to the measurement of the resistance of accumulators by observations covering day and night, to determine the resistance during the entire discharge and charge for various currents. For each of these currents the cells are being brought

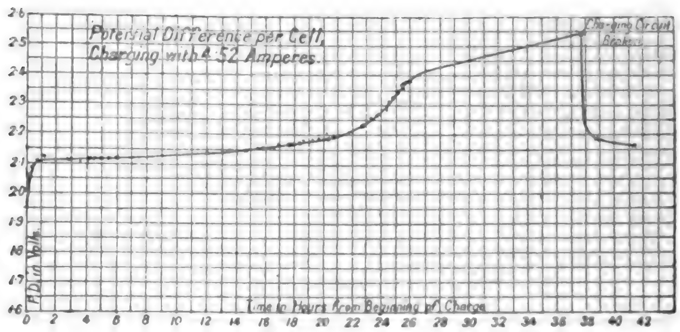


FIG. 3.

to a steady working state by many discharges and charges being successively and without interruption made with each current. In the case of the small current the time of a charge and discharge is tediously long, the charge, for example, with 8 amperes requiring 40 hours to raise the P.D. from 1.9 to 2.4 volts per cell, so that several weeks have to be spent obtaining the resistance for this current. This investigation of resistance is not yet completed, and the authors do not in this paper refer to the variation of the resistance of a cell with different currents when the cell is brought to a *steady working state for each current*. Such an experiment has not, as far as the authors are aware, ever before been attempted with accumulators; former observers have contented themselves with merely observing the variation of the resistance when the current during discharge or charge was abruptly

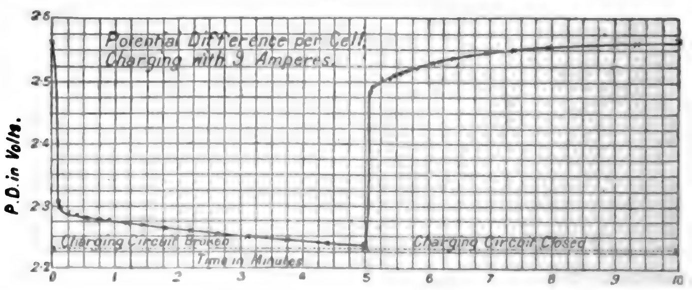


FIG. 4.

changed from one value to another. This is a very different thing from ascertaining how the resistance of an accumulator varies with the current when *each* of the different currents employed is steadily used for some weeks in the discharging and charging of the cell, until the cell has arrived at a steady working state for the current in question.

It is stated, in conclusion, that the results obtained with accumulators made to go for long periods through definite cycles in charging and discharging, having been so interesting that the authors are now engaged on the design of an apparatus which will automatically keep the current constant for any time at any pre-arranged value, which will automatically change over from charge to discharge, or from discharge to charge, when the P.D. per cell reaches any pre-arranged limit, and which will record the P.D. at the terminals of the cell, and also its E.M.F. during the whole period. They hope, therefore, at some future period to be able to present a graphical record of the life-history of accumulators from their first formation to their death.

THE NEW CABLE TO FRANCE.—M. Jules Roche asks $80,000 of the Chamber for a new telegraphic cable between France and England. The existing cables can hardly meet the increased demand for their services which rose last year during the exhibition. M. Jules Roche calculates that the entire cost to France of this telegraphic enterprise will be nearly $140,000. Last year the increased profit to the State, in consequence of the increased business, was over $75,000.

CORRESPONDENCE.

MINNEAPOLIS.

The Approaching Electrical Exhibition.—The Edison Convention.

The electrical exhibit which is to be made at the Minneapolis Exposition, which opens August 27th, and closes October 4th, will be the most complete display of its kind ever made. It will include not only the Edison exhibit made at the Paris Exposition in 1889, but will be more complete in every way, and in addition will contain an exhibit by the Thomson Electric Welding Company, of Lynn, Mass. The Edison exhibit is already on the ground, and is being arranged under the direction of Luther Stieringer, of New York. Nearly three car loads of electrical material to be used in the exhibit have arrived. The principal feature is a "Tower of Glory," the plans for which were drawn by Mr. Stieringer. The tower has been built in the centre of the building and is about 70 feet high and 8 feet in central diameter. It is of Egyptian design and is to be covered with 7500 incandescent lamps. From the top of the tower festoons of lamps will hang in various designs, making it the most brilliant lighting spectacle in the world. The Edison exhibit includes the talking dolls and an electric railroad, the various telephone devices, the telegraph instruments as seen in Paris and at the Lenox Lyceum, the phonographs, dynamos, etc. The working of all this apparatus is to be illustrated by experts from Edison laboratory. The Thomson electric welding apparatus, by which dissimilar metals are united, will also be in actual operation, and much interest is being manifested in the exhibit. Mr. W. M. Regan is general manager of the exhibition.

The convention of the Edison Illuminating Compannies will be held in Minneapolis, September 16th. A large number of delegates are expected to be present. There will also be a very extensive exhibit by the Carpenter-Nevens Electric Heating Co., who will have in practical operation a variety of very recently patented electrical apparatus, soldering tin-ware, ironing laundry-work, pressing clothing, frying doughnuts, etc., and various other appliances of heat by electricity. There will also be a very extensive exhibit by the power department of the Edison General Company, and a very extensive line of exhibits in electrical merchandise and apparatus.

MINNEAPOLIS, Aug. 7, 1890.

CHICAGO.

An Electric Fountain for Lincoln Park.—The Calumet Electric Railway.—Electric Railway Notes.

The new electric fountain presented by C. T. Yerkes to the Lincoln Park commissioners, which has been in course of erection for several months, is now about completed. It is probably the largest one of its class in the country. The fountain contains over 200 large jets, all of which are in play together and throw varying streams to the height of seventy-five feet. In addition to these there are numerous smaller jets which furnish an abundance of spray. The electrical part of the fountain is not yet entirely completed but will be finished in a few days, when a formal opening will probably be made, with music and other features. It is stated that the making of such a gift was first suggested to the donor during a visit to the Paris Exhibition, where the prismatic fountain proved to be one of the leading features of the display; and immediately on his return the offer was made to the commissioners to place a similar one in Lincoln Park, which was gladly accepted.

The fountain when completed will be one of the most beautiful and novel sights imaginable. The spray, sent up to a great height, will separate into innumerable drops, each of which, like a prism, will reflect the light thrown upon it by the electric lights and shine like diamonds. The fountain, when complete, will represent a cost of $50,000. In repose the fountain is not an imposing affair, the visible portion being a maze of pipes and tubes within a circular wall. It is on the Lake Shore drive near the ball grounds. When the pumps are at work, and the light thrown on it, the fountain will present a most beautiful and striking appearance. A very satisfactory test of the fountain has now been made.

Prof. Barrett will soon place electric lights in that section of the South Side lying between the river and Twenty-second street. The power house is being built on Fourteenth street and Indiana avenue.

The complications which have retarded the work on the Calumet electric railway are being removed and the road will be rapidly pushed forward. The city council has passed an ordinance extending the time in which the first section of the road, from the works of the Illinois Steel Company, in South Chicago, to Stoney Island avenue, must be laid, and J. J. Harvey, the president of the road, has agreed to the conditions exacted by the council. Two blocks of track on Ninety-third street, and about a block on South Chicago avenue, have been laid, and work on the eastern portion, near Calumet Heights and Dauphin Park, has been steadily carried on. It is expected that cross lines will be run due east from this line to the country lying in the vicinity of Washington Heights and Fernwood. It is said that efforts are being made to avoid the use of the overhead trolley system; and an entirely new system, by which only the part of the rail over which the car is passing will be charged, is now under consideration.

At Joliet last week a telephone wire on Cass street broke and fell on the electric railway wire. This carried an electric current into the central office, which set fire to the switchboard. The cable consisting of one hundred conductors was burned out. It is a pity the telephone wires are not kept in better condition.

The Chicago and Lake Shore electric railway was incorporated last week, the names of the incorporators being F. L. Brooks, C. H. Romy and George A. Fairbanks. This project has been under consideration for several months, and provides for a fully equipped electric road, parallel with, and as near as possible to, the north lake shore from Chicago to Fort Sheridan, and later to be continued along the lake to Waukegan. The estimated cost of the first section of the road is $1,500,000, and it is to be put in such condition that passengers may be carried from Chicago to Fort Sheridan, a distance of twenty-five miles, in fifty minutes. Mr. C. H. Remy states that the backers of the scheme are Pittsburgh and Boston capitalists, that the road is to be built, and negotiations are already going on for the right of way. It is rumored that the Westinghouse Electric Company is interested in the scheme. It is also reported that Mr. Westinghouse has just perfected a motor car that will do away with overhead wires entirely in the business centres, using them only on a part of the line. This motor will have properties enabling it to accumulate energy while being propelled by the current from the overhead wire, thus combining the overhead system with the storage system.

CHICAGO, Aug. 9, 1890.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.
Anonymous communications cannot be noticed.
The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.
In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.
Sketches and drawings for illustrations should be on separate pieces of paper.
All communications should be addressed EDITOR OF THE ELECTRICAL ENGINEER, *150 Broadway, New York city.*

SOME REMARKS ON ELECTRICAL VIVISECTION.

[133.]—Now, that the long-deferred Kemmler execution has taken place, it may be well to look a little more closely at some of the circumstances surrounding the case, which have so far not received attention.

During the taking of the testimony before a referee, a large number of witnesses were examined, some for and some against the carrying out of the sentence in the manner and by the means which were finally employed. It must be remembered that none of these latter witnesses contended that electricity would not kill. Their only contention was that the use of a commercial machine of only 1,000 volts tension would not render death either instantaneous or painless.

On the other hand, a number of supposed scientists and medical men contended that the merest touch of a wire carrying 1,000 volts would most certainly be fatal, and painlessly so. None of these scientists and doctors would admit ever having received a shock of even ordinary severity, and reasoned entirely from theory, or from experiments on animals; experiments which were never conducted in a manner calculated to give any exact knowledge of the circumstance and conditions. Not only this, but men who testified that they had received without serious injury, but with indescribable agony, shocks from machines of this description (with bare hands, perhaps greasy, perhaps wet, and their conditions of contact varying from a firm grasp to a mere touch) were laughed at, and all but openly accused of perjury.

The only experiment which can have any real value in determining what will kill a human being, that is, an experiment *on* a human being, has taken place, and already these doctors and scientists are giving their widely differing opinions as to the reasons for the disgraceful exhibition which took place. One scientist has already stated that it was because the contacts were made with the head and spine, instead of through the hands. We may shortly expect another to claim that the shock should have been given from the head to the feet, as was originally designed. In short, when doctors disagree, who shall decide?

That death was not instantaneous must be conceded. That the death was painless, all the doctors are very sure. This may be a very comfortable and satisfying conclusion for them to reach, but there is another view to be taken. Seeing that these doctors were certain that death would be instantaneous, and that in spite of months of careful preparation, with the current applied under

conditions vastly more favorable to death than ever before, that death did not take place after an application of the current for 17 seconds, and that the victim began to revive after four doctors had pronounced him dead, thinking people may well inquire whether it would not have been well to lay a little more stress on the testimony of witnesses before the referee, who contended that death would be intensely painful even if sure, and that the machine to be used for the purpose was an improper one. It is but scant justice to these witnesses who have been so much maligned to call attention to the utter refutation of the medical testimony afforded by the scene in Auburn Prison, and the strong corroboration of the testimony of the many linemen and others who were hooted at because they claimed that they had survived shocks from the same apparatus, but far less severe than that with which it was attempted to kill Kemmler.

ONE OF THE WITNESSES BEFORE THE REFEREE.

REPORTS OF COMPANIES.

PACIFIC POSTAL TELEGRAPH. CO.

The annual meeting of the Pacific Postal Telegraph Company was held at 1 Broadway on August 5, and these directors were elected: John W. Mackay, W. C. Van Horne, George Stephens, Charles R. Hosmer, Richard V. Dey, Albert B. Chandler, Hector De Castro, Edward C. Platt, and George G. Ward. The Pacific Postal is a line of telegraph running along the Pacific Coast. As the names of the directors show, it is closely related to the Postal Telegraph and Cable Company.

ERIE TELEPHONE CO.

A quarterly dividend of 1 per cent. has been declared on Erie Telephone stock, payable Aug. 18, to stockholders of record Aug. 8. Books closed from Aug. 8 to Aug. 17, inclusive. The combined report of the Cleveland Telephone Company, the Northwestern Telephone Exchange Company, and the Southwestern Telegraph & Telephone Company, for the three months ended June 30, 1890, is as follows:

QUARTER ENDED JUNE 30.

	1890.	1889.		
Gross	$189,393	$177,068	Inc.	$12,304
*Expenses	131,549	118,672	Inc.	12,877
Net	$57,843	$58,461	Dec.	$578
Dividends	48,000	48,000		....
Surplus	$9,843	$10,416	Dec.	$578

SUBSCRIBERS ADDED.

	1890.	1889.		
Quarter	417	249	Inc.	168
Total connected, July 1	12,662	11,564	Inc.	1,098

*Includes construction.

The increase in the expenses undoubtedly indicates a large amount of construction work going on. The surplus is over $7,000 in excess of the previous quarter's surplus. The three subcompanies, after paying all their expenses and the dividends to the Bell and Erie companies, retain a surplus of $9,843. The Erie company, after paying one per cent. from its portion of the dividend received from the three companies, reserves $8,601, or a total surplus for the quarter of $18,444. The increased earnings and surplus are attributed to the large increase of subscribers, 250 having been added the first quarter of this year, and 417 the second, or a total of 667 in six months. The Erie company now has a cash surplus exceeding $73,000.

UNION TELEGRAPH & TELEPHONE CO.

The directors of the Union Telegraph & Telephone Company (operating in the State of New York) have declared a dividend of one per cent., payable Aug. 18 to stockholders of record Aug. 8. The quarterly statement is as follows.

QUARTER ENDED JUNE 30.

Gross earnings	$6,216
Expenses and construction	5,107
Net earnings	$1,109
Dividend	1,000
Surplus	$ 109
Total surplus, June 30	$1,258
Number of subscribers	506

DIVIDENDS.

TROPICAL AMERICAN TELEPHONE CO.—At a meeting of the directors of the Tropical American Telephone Company, held August 5, it was voted to pay a dividend of 1 per cent. or 10 cents per share on the 15th day of August, to stockholders of record August 1st, and a further dividend of 10 cents per share on the 1st day of October to stock of record September 15th, and that in future the dividend days will be April 1st and October 1st. The general manager's report showed a gain of nearly 100 per cent. over the preceding year, and the treasurer's report showed $24,000 and about $25,000 bills receivable in excess of debts. Mr. Harry Highley was elected secretary and treasurer.

QUINCY, MASS.—The Quincy Electric Light and Power Co. has declared a dividend of 5 per cent.

THE AUTOMATIC FIRE ALARM AND EXTINGUISHER CO., L't'd., of 413 Broadway, this city, has declared a dividend of 2 per cent., payable August 15.

FINANCIAL MARKET.

QUOTATIONS OF ELECTRICAL STOCKS.

Mr. F. Z. Maguire, Electrical Securities, of 18 Wall street, this city, reports the following quotations of August 9 from New York, Boston and Washington:—

NEW YORK.

	BID.		BID.
W. U. Tel. Co	83	Edison Gen. Elec. Co	105
American Tele. & Cable	88	Edison Gen. Co. Def'd	94
Centl. & So. Amer	155	Consol'd Elec. Lt. Co	60
Mexican	205	Edison Illn'g Co. N. Y.	70
Com. Cable Co	101	U. S. Elec. Lt. Co	35
Postal Tel. Cable	35	North. Am. Phon'gph	65

BOSTON.

	BID.		BID.
Thomson-Houston	50	Ft. Wayne Co	12¼
" Pref'd	25¼	Am. Bell	225
" Series C	12½	Erie	52¼*
" " D	6½	New England	52¼
" Int. Co	....	Mexican	80 cts.
Thomson Welding Co	....	Trop. American	1½
Thomson Eu. Welding	90	Edison Phon'gph Doll	3¼

*Ex. Dividend.

WASHINGTON.

	BID.		BID.
Penna. Telephone	25	U. S. Elec. Lt. (Wash)	165
Ches & Pot. Telephone	77*	Eck. & Sold. Home Elec. Ry	69
Amer. Graphophone	16		

*Ex. Dividend.

PITTSBURGH.

	BID.
Westinghouse Electric Manufacturing Co	39

METAL AND SUPPLY MARKET.

COPPER PRICES.

Quietude has characterized the Metal Exchange for another week. Copper fell off slightly from August 1 to August 8; margins were called to 17 cents on the 1st and to 16.80 cents on the 8th. Official closing figures of 8th, compared with a week previous and a year ago, are given as follows:

	August 8.	August 1, 1890.	August 9, 1889.
Straits tin, spot	20.90	20.80	19.95
Straits tin, Oct	20.90	20.90	19.95
Lake copper, Aug	16.80	17.00	11.80
G. M. copper, Aug	—	—	9.50
Domestic lead, spot	4.45	4.45	3.85
Domestic spelter, Aug	5.40	5.40	—

SHIP SIGNALING TELEGRAPHY.

Commander Percy Scott, of her Majesty's ship "Excellent," has designed a flash signaling lantern to enable flash signals to be sent on the Morse system with greater rapidity than has heretofore been possible and from a point where the present mechanical arrangement of shutter could not well be employed. The lamp is surrounded by a number of vertical shutters, pivoted at top and bottom, and engaging by means of short arms or toothed wheels with a central wheel. The motion of the latter is produced by an electro-magnet, and an electric lamp of 100 candle power is used. A Morse instrument can be added, whereby the signals may be automatically recorded in the same way as in telegraphy. The action of the lantern is very satisfactory, and one has been used for several months on board the "Northumberland." It is hoped that by means of this lantern it may be possible to attain such speed in flash signaling that two parties may be able to interpret each other's signals, which, owing to the different rates at which signals are sent, is now found to be very difficult.

LEGAL NOTES.

NEW YORK SUBWAY LITIGATION.

The North American Underground Telegraph and Electric Company, which controls the Johnstone system of conduits or subways, brought suit recently against the Consolidated Telegraph and Electrical Subway Company and the New York Underground Telegraph Company to enforce a contract for the use of the Johnstone system and to recover $2,500,000 as damages on account of the failure of the subway company to keep the terms of the contract and put the system in operation. In this suit Judge Beach, in Supreme Court Chambers, was asked on August 7, by Charles W. Brooke, the counsel for the North American Underground Telegraph and Electric Company, to grant an injunction restraining the subway company from using or operating, laying or building any underground conduits in this city except under the Johnstone system.

Should an injunction of the extent asked for be granted, the city would again be placed in a peculiar position as regards its lighting by electricity, as comparatively only a small portion of the electrical lighting subways are equipped on the Johnstone system. Much confusion would also naturally result in respect to the subways for other wires. While reserving his decision, Judge Beach indicated as plainly as possible, without saying so, that he did not consider the case one in which an injunction should be granted.

ELECTRIC RAILROADS AND TELEPHONES AT ALBANY, N. Y.

Referee Lawson rendered a decision at Albany on Aug. 8, in the action of the Hudson River Telephone Company against the Watervliet Turnpike and Railroad Company for an injunction restraining the latter from operating its cars by the single trolley system, and for damages for impairment of its business by grounding its circuit. The referee holds that neither the application for an injunction nor for damages can hold, and dismisses the action. The railroad company has been restrained from operating its cars by electricity by temporary injunction pending the action. It will immediately bring suit for damages.

SOCIETY AND CLUB NOTES.

THE CAPE MAY MEETING.

Mr. Allen R. Foote, secretary of the National Electric Light Association, has issued a very handsome souvenir giving all the necessary details with regard to the arrangements for the Cape May meeting, which begins on August 19. The information given has already appeared in our columns, and Mr. Foote has put it together in admirable form.

In regard to the departure from New York, it may be stated that Messrs. John A. Seely and C. W. Price have, as a special committee, made plans for a party to leave this city for Cape May on Saturday, August 16, at 1:50 p. m. from the foot of Cortlandt street. This is an excellent idea, and all who wish to join the party should communicate with Mr. Seely, at 24 Cortlandt street.

OBITUARY.—W. H. ABEL.

William H. Abel, who had been prominently connected with the telegraph business almost from its beginning until forced by failing health to retire from active life, died on August 9. Mr. Abel was about fifty-four years of age. He was graduated from the College of the City of New York and for two years afterward acted as a tutor in the institution. He then gave up teaching for business, and entered the service of the American Telegraph Company, soon advancing to the position of auditor. When the American was finally merged into the Western Union Company he continued in the employ of that company. For a few years he acted as assistant secretary, and was then made chief auditor, holding that position until 1872, when poor health made it impossible for him to discharge the arduous duties of the office.

OBITUARY.—J. H. WADE.

Jephtha H. Wade, one of the oldest and wealthiest citizens of Cleveland, died there on August 9, after an illness of only a few days, aged seventy-nine years. Mr. Wade began life as a carpenter, was afterwards a daguerreotype artist, and then a telegraph operator. He built the first telegraph line west of Buffalo along the line of the Michigan Central Railroad. He next built the Wade lines to Ohio. He was the first president of the Pacific Telegraph Company, and the first president of the Western Union, which position he held till 1867. He has since been engaged in banking and other enterprises in Cleveland. He originated Lake View Cemetery where Garfield is buried, and also laid out and donated to the city Wade Park near the cemetery.

Mr. Wade invested in telegraphy at the right time and realized several million dollars from his investment. He was very charitable, among his gifts to the city of Cleveland being the park and an orphan asylum. Mr. Wade was a Democrat and had often been importuned to run for Congress, but always refused. His fortune is said to amount to $8,000,000.

In telegraphic circles, Mr. Wade will be remembered not only as being the first president of the Western Union Co., but as having been one of the chief promoters of the transcontinental lines, and of the projected line to Russia and Europe across the Pacific and Siberia. He showed himself in telegraphic work a man of great force and inventive ability.

INVENTORS' RECORD.

Patents issued August 5.

Alarms and Signals:—*Municipal Signal System*, B. J. Noyes, 433,485 and 433,486. *Municipal Signal Apparatus*, J. C. Wilson and B. J. Noyes, 433,504. *Light-Signal System*, J. C. Wilson, 433,505. *Electric Alarm Letter Box*, W. B. Detwiller, 433,560. *Electric Fire-Alarm and Night-Call*, C. J. Vining, 433,584. *Door-Bell*, C. A. Emme, 433,724.

Conductors, Conduits and Insulators:—*Insulating Material*, J. Fottrell, 433,893. *Method of Manufacturing Electric Conductors*, E. P. Warner, 433,917. *Joint for Electric Conductors*, G. L. Wiley, 433,920, 433,921 and 433,922.

Distribution:—*Electrical Transformer or Induction Device*, N. Tesla, 433,702. *Electric Current Controller*, M. O. Sargent, 433,744. *Current-Converting Apparatus*, C. Zipernowsky and M. Déri, 433,758.

Dynamos and Motors:—*Commutator for Dynamos*, J. W. Easton, 433,523. *Dynamo-Electric Machine*, C. F. Winkler, 433,557. *Alternating-Current Electro-Magnetic Motor*, N. Tesla, 433,700. *Alternating-Current Motor*, N. Tesla, 433,701. *Electro-Magnetic Motor*, N. Tesla, 433,703. *Induction-Motor*, C. J. Van Depoele, 433,834. *Electric-Motor Mechanism*, S. E. Mower and G. J. Spencer, 433,904.

Galvanic Battery:—*Galvanic Battery*, S. W. Maquay, 433,738.

Lamps and Appurtenances:—*Electrolier*, E. W. Little, 433,687. *Incandescent-Lamp Socket*, T. G. Roebuck, 433,698. *Electric Arc Lamp*, S. P. Parmly, 433,908. *Ceiling-Block for Incandescent Electric Lamps*, A. T. Tregwitha, 433,915.

Measurement:—*Electrical Measuring Instrument*, E. Weston, 433,637.

Metal Working:—*Electrical Soldering Iron*, C. E. Carpenter, 433,671.

Miscellaneous:—*Thermo-Electric Element*, E. N. Dickerson, 433,451. *Lightning Rod Tower*, I. F. Field, 433,459. *Electric Release for Target Traps*, L. I. True, 433,554. *Cleat for Electric Wires*, L. Furlong, 433,561. *Fusible Cut-Out*, W. J. Jenks, 433,682. *Fuse and Fuse-Block*, J. G. S. Cunnington, 433,770.

Railways and Appliances:—*Electric Railway*, A. A. Shore and W. Embley, 433,544. *Trolley for Electric-Motor Cars*, Forée Bain, 433,611. *Electric Circuit Coupling for Railway Trains*, W. P. Widdifield and A. H. Bowman, 433,706. *Trolley for Electric Street Cars*, F. C. Wheeler, 433,839. *Device for Unloading, Recharging and Reloading Electric Car Storage Batteries*, J. C. Chamberlain, 433,851. *Support for Electric Wires*, A. L. Hallbauer and E. L. Hiller, 433,896. *Electric-Railway-Conduit System*, M. Wheless. 433,918.

Telegraphs:—*Electrical Communication*, J. L. Cutler, 433,619. *Telegraph-Key*, J. B. Van Deusen, 433,835.

Telephones and Apparatus:—*Registering System for Telephone Exchanges*, J. C. Clark, 433,445. *Multiple Switch Board System*, E. P. Warner, 433,636.

EXPIRING ELECTRICAL PATENTS.

Reported by F. B. Brock, *Patent Attorney*, 639 *F street*, *Washington*, *D. C.*

Expired in April, 1890.

Annunciator, J. H. Corey, 137,422, April 1, 1873. *Battery*, R. M. Lockwood, 137,556. *Boat Steering Apparatus*, H. J. Smith, 137,574. *Relay and Sounder*, J. E. Smith, 137,730, April 8, 1873. *Connector*, F. Schurz, 137,801; T. Wishart, 137,810. *Electrical Tools and Machines*, Jacques, Oakley & Sterne, 137,875, April 15, 1873. *Underground Line*, E. H. Austin, 138,115, April 22, 1873. *Separator*, S. J. Peet, 138,276. *Induction Coil*, J. S. Camacho, 138,316. *Exploding Apparatus*, S. A. Briggs, 138,373. *Friction Generators*, F. H. Varley, 138,455, April 29, 1873.

Expired in May, 1890.

Insulator, Eby & Fenninger, 138,489; E. A. Merrill, 138,512. *Battery*, L. Bastet, 138,602. *Exploding Apparatus*, Mott & Gardiner, Jr., 138,679, May 6, 1873. *Electrical Machine or Tool*, B. Bevelander, 138,783. *Motor*, S. C. Carter, 138,855. *Printing Telegraph*, T. A. Edison, 138,869 and 138,870. *Telephonic Telegraph System*, R. Henning, 138,899. *Burglar Alarm*, H. E. Walter, 138,965, May 13, 1873. *Regulator*, H. A. Chapin, 138,993. *Printing Telegraph*, T. A. Edison, 139,128 and 139,129, May 20, 1873. *Duplex Telegraph*, G. D'Infreville, 139,302. *Railway Signal*, Digny, Lartigue & Forest, 139,376. *Insulator*, I. I. Tatoni, 139,436, May 27, 1873.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

THE CROSBY ELECTRIC CO.

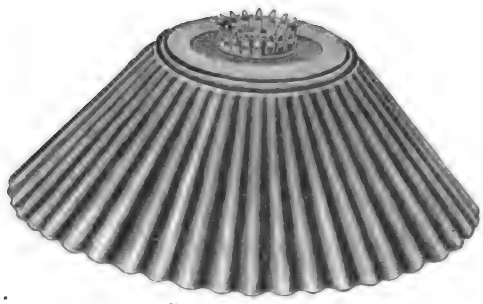
The above company has just issued the following circular from its headquarters in the Judge building, Fifth Avenue and Sixteenth street:—"The Crosby Electric Co. desires to notify its friends and the trade generally that it has purchased the Eclipse Electric Co., of New York City, with its business and stock on hand, together with the patents under which the Hussey Eclipse and the Duplex batteries are manufactured, and that, hereafter, the business and manufacture of said Eclipse Co. will be carried on under its management. It is prepared with a full line of everything necessary to the conduct of the business, and will guarantee strict attention and prompt delivery of all orders entrusted to it."

THE MAGNOLIA ANTI-FRICTION METAL.

We have had occasion more than once to remark upon the remarkable felicity of the Magnolia Anti-Friction Metal Co., of 74 Cortlandt street, in its choice of means for advertising its specialty. The judicious use of the advertising columns of the best technical journals, is supplemented from time to time by the publication of music, novelettes, pictures, etc., all bearing the name of Magnolia. The company has now struck the happy and rather original idea of issuing a calendar at midsummer, and we have received from it a handsome one which runs from July, 1890, to July, 1891. It is a beautiful piece of chromo-lithographic work in numerous colors, and gives views of the Brooklyn Bridge, the Statue of Liberty and the Eiffel Tower, with the chief data of the constructional features. The magnolia is a prominent object, and a cut is also shown of a bearing lined with the justly celebrated compound.

A NOVEL CONE SHADE.

Tin shades being cheap and unbreakable, there has always been a call for them from factories, mills, stores and other places where porcelain shades would prove too costly; the more so as the bright tin really reflects the light better than the expensive porcelain or glass shade. A year ago Mr. Geo. Cutter, now manager of the Great Western Electric Supply Co., went a step farther and designed a tin shade which required no shade holder.



TIN CONE SHADE FOR INCANDESCENTS.

The popularity of this "Combination Tin Shade," of which 20,000 are now in use, has now led the above firm to bring out a new pattern called "Cutter's Combination Cone Shade." As the cut shows, it is of a deep cone shape, making it well fitted for the use of book-keepers, draughtsmen, engravers and others who want the light concentrated on their work. As it fits the Thomson-Houston, Westinghouse and Sawyer-Man sockets directly, it is bound to hang square at all times. Its convenience, together with its cheapness, will probably cause it to be widely used for lights over desks and the like.

CONSOLIDATED FRUIT JAR CO.

The above company, of New Brunswick, N. J., and this city, have issued a very neat and effective calendar on decorated tin, the work of their own lithographing department. The company have a fine factory at New Brunswick, of which a view is shown on the first calendar sheet. They make a specialty of fuse wires, several samples of which are attached to the calendar. They also manufacture sheet metal novelties, brass castings, shade holders, battery screw tops, and spun and drawn work in all metals. They are equipped for electrical work of all kinds, and have had an extensive experience in the production of switches, sockets, cutouts, etc.

W. H. GORDON & CO.

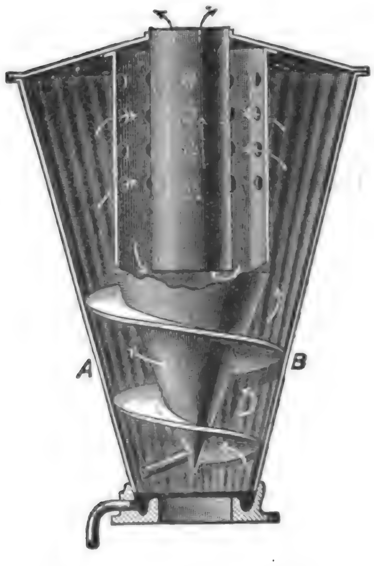
The above concern, of 115 Broadway, have, in addition to their regular large sales of electrical supplies, been extremely busy on Simplex wire for electric railway work. Mr. Gordon reports large sales within the last few days, aggregating not less than 50 miles. This wire enjoys a high reputation among electric railway people, for its qualities of insulation, etc., and a noteworthy feature of the orders is the promptness with which they are shipped.

THE JENNEY ELECTRIC MOTOR CO.

A very tasteful and interesting pamphlet on "Electric Motors and the Transmission of Power by Electricity" has been issued by the Jenney Electric Motor Co., of Indianapolis. It contains illustrations and descriptions of their motors; some excellent general remarks on the subject of power; data for power users, and a number of testimonials from people who have the motors in service.

THE NICETY OF MODERN STEAM-ENGINE APPLIANCES.

THE centrifugal exhaust pipe head, illustrated on this page, and for which Hine & Robertson, 45 Cortlandt streets, are agents, will be heartily welcomed by engineers who have gone through the more or less fruitless task of reducing the loss of thermal units set free in the boiler on their way to the cylinder. The oil fed into the cylinders of the engines, pumps, etc., passes out with the exhaust steam, which soon condenses and is deposited on the roofs, skylights and other places, injuring the roofs, coating the skylights, and in many cases dropping into the streets to the great annoyance of the



HEAD FOR EXHAUST STEAM.

public. The centrifugal exhaust head, illustrated, was brought out to remedy these troubles, and has met with such success that one company alone, the Sawyer-Man Electric Co., of N. Y., have seven on their plant, ranging in size from 12" down to 4". With a view of determining its efficiency, a test was made of a 12" for some weeks, and the very satisfactory results warranted them in purchasing six more. Unlike other heads, it has no diaphragms for the steam to strike against and create back pressure and a loud thumping noise, but is constructed with a spiral interior, giving to the steam on entering a centrifugal motion, forcing all oil and water against the sides, leaving the cleansed steam an opportunity to pass out through the perforated central pipe. The oil and water can be carried to any point through the small drip pipe at the bottom.

WESTINGHOUSE ALTERNATING PLANTS

An alternating current central station plant of incandescent electric lighting is about to be established at Waycross, Ga. The company organized there has just awarded the contract for the apparatus to the Westinghouse Electric Manufacturing Company. The plant will have a capacity of 750 lights, and the installation will be begun at one.

The Westinghouse Electric Manufacturing Company has obtained the contract for furnishing its alternating current apparatus to a company recently organized at Bryan, Tex. The plant will have a capacity of 500 lights.

Helena, Mon., as the capital of that youthful State of the Union, is showing all other cities and towns a good example by improving her illumination. A number of enterprising citizens who have established an electric light company are now erecting a plant both for arc and incandescent lighting with a capacity of fifteen hundred incandescent and forty arc lights. The plant will be furnished with the Westinghouse alternating current system.

FINE ELECTRICAL HOUSE WORK.

Mr. John Lewall, formerly with Pernaux & Co., has taken the quarters 6 East 17th street, lately occupied by that firm, and will there make a specialty of fine electrical work for churches, houses, theatres, stores, &c. He was in the service of the old firm as superintendent, and will maintain the reputation secured by the high quality of work done. Among the references are such concerns as Tiffany & Co., Eimer & Amend, J. D. Rockefeller, H. M. Flagler and others. Mr. Lewall has already been given the support of many old patrons.

FITCHBURG ENGINE CO.'S WORK.

The Fitchburg Steam Engine Co. write us as follows:—"We are very busy just now on contracts. We are fitting out the complete steam plant for the U. S. Government at Watervliet Arsenal, West Troy, N. Y.; are also building an engine for Farley Paper Co. at Erving, Mass.; shipping three large engines to Chicago; putting in engine and boiler for the Chas. Parker Co., Meriden, Conn.; also an engine for the Meriden Britannia Co.; putting in two engines for the Falulah Paper Co., Fitchburg, and one engine for the Fitchburg M'f'g. Co.; fitting out complete plant, engine, boiler, etc., in Shirley, Mass.; also building an engine for the Baldwinville Hospital, Mass., and one large compound engine for a Cold Storage Co.; one for the Real Estate Trust Co., Swanton, Vt.; putting in complete plant for the Electric Light Co., at Princeton, N. J.; also putting in a large plant with engines, boilers, etc., for the Clinton Electric Light Co., Clinton, Mass.; also complete plant at Kingston, Mass.; also two engines, boilers, etc. for a large paper mill in Delaware, besides a variety of other work. The company propose to double their capacity."

THE INTERIOR CONDUIT AND INSULATION CO.

A new catalogue and price list has just been issued by the above company, of 16 and 18 Broad street, fully illustrated and comprising many interesting details of the system and its method of introduction into public buildings and houses.

THE GREAT WESTERN ELECTRIC SUPPLY CO.

The Great Western Electric Supply Co., Chicago, have lately been receiving immense quantities of batteries, bells, annunciators and electric gas lighting apparatus, but, thanks to the well worked out methods of handling and storing goods, no annoyance or delay is caused. They also report heavy orders for their street-hood and porcelain cut-outs, besides the steady call for Simplex wire. They have already made some slight improvements in the Pattee Lamp Hour Recorder, and are filling orders with what is even a neater and more assuring form than that recently illustrated in our columns.

THE CONVENIENCE OF THE ELECTRIC MOTOR.

Mr. G. A. Redman, the superintendent of the Brush Electric Light Co. at Rochester, N. Y., writes us as follows: "We have installed two novel C. & C. motor services here lately. In one case a lady was very sick, and it was necessary to have some one fan her continuously. In order to meet the emergency a revolving fan was placed in her room run by the motor in the adjoining room. Thus she was able to get all the relief that fanning could give, without any fatigue to an attendant and without noise or discomfort. In the other case, a man was confined to his bed with a broken knee cap. A C. & C. motor with brass fan was placed in the corner of the room about 8 feet distant from the bed, with a cord run from the switch, so that the motor and fan could be switched on or off as desired. The sick man says that 'It is a darling,' and he would not part with it for any price"

THE EDISON GENERAL COMPANY'S DISTRICTS.

The following circular has been issued by Mr. James F. Kelly, of the wire department of the Edison Machine Works, with the approval of Vice-President Insull:—

We beg to inform you that the business of wire insulating heretofore carried on by the Edison Machine Works, has been transferred to the Edison General Electric Company, and will henceforth be conducted as a department of that company.

The Edison General Electric Company will have district offices in New York, Chicago, Denver, San Francisco, Portland, Oregon, New Orleans and Toronto. These districts will carry a comprehensive stock of the wires manufactured by the wire department. The districts named will supply the territory as indicated below:

Eastern District.—CHAS. D. SHAIN, *Manager*, 16 *Broad street, New York City*, Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, New Jersey, Delaware, Maryland, Virginia and West Virginia.

Central District.—JOHN I. BEGGS, *Manager, Rialto Building, Chicago, Ills.*, North Dakota, South Dakota, Minnesota, Iowa, Missouri, Wisconsin, Illinois, Michigan, Indiana, Ohio and Kentucky.

Rocky Mountain District.—GEO. W. COSTER, *Manager, Masonic Building, cor. 16th and Welton streets, Denver, Colo.*, Kansas, Nebraska, Colorado, Wyoming, Montana, Utah and New Mexico.

Pacific Coast District.—W. S. HEGER, *Manager, Room* 6, *No.* 4 *Sutter street, San Francisco, Cal.*, California, Nevada and Arizona.

Pacific Northwest District.—S. Z. MITCHELL, *Manager, Portland, Ore.*, Oregon, Washington and Idaho.

Southern District.—O. T. CROSBY, *Manager, Cotton Exchange Building, New Orleans, La.*, Texas, Arkansas, Indian Territory, Louisiana, Mississippi, Tennessee, Alabama, North Carolina, South Carolina, Georgia and Florida.

Canadian District.—M. D BARR, *Manager, Bank of Commerce Building, Toronto, Ont.*, British Columbia, Northwest Territory (Athabasca, Alberta, Assiniboia and Saskatchewan), Manitoba, Ontario, Quebec, New Brunswick, Nova Scotia, Northeast Territory, Labrador, Newfoundland.

In all business matters with this company we request that you will communicate with the district office operating the territory in which your business is located.

C. & C. ELECTRIC MOTOR CO.

Messrs. E. G. McDougall and T. C. Cummings have assumed charge of the Chicago office of the C. & C. Electric Motor Co. Among the motors recently placed in their district are three of 10, 15 and 4 h. p., respectively, in the works of Cameron, Amberg & Co., the letter file makers, running the entire shops off the Edison circuit. There has also been an increase of a 15 h. p. C. & C. motor in the Chicago Auditorium.

THE NEW WOOD ARC SYSTEM.

Mr. H. C. Adams, the representative of the Fort Wayne Co., 115 Broadway, informs us that since October last they have sold no fewer than 9975 arc lamps of the new "Wood" system. This he naturally looks upon as a remarkable evidence of the popular approval with which the system is received.

ELECTRICAL CHAIN-HAULING IN A GERMAN COAL MINE.

An account of an electrical chain-hauling system in a coal mine near Beuthen, Silesia, Germany, is given in a recent issue of the *Zeitschrift fur das Berg-Hutten und Salinen-Wesen.*

According to the abstract given in the Excerpt Minutes of the Proceedings of the British Institution of Civil Engineers, the gallery in which chain-hauling is employed is about 500 yards long, having a double line of rails, of 25-inch gauge. The number of wagons dealt with per shift of ten hours is 800, weighing 440 tons.

In a continuation of the gallery is situated the driving drum, 6.55 feet in diameter, mounted on a vertical axis, around which the chain is wound one-and-a-half times. The chain having been conducted over a system of tightening pulleys, it is guided into the centre of each line of rails, one for the full and one for the empty wagons. At the opposite end of the gallery it passes around a vertical pulley 4.8 feet in diameter, equal to the distance from centre to centre of the rails. The bearings of this pulley rest in a channel iron so as to admit of tightening. The links of the chain are 0.80 inch in diameter, and it weighs 15 pounds to the yard. It rests on the top of the wagons, and is kept in that position by two vertical projecting pieces. The wagons are placed at intervals of 20 yards on the chain.

The current is supplied from the surface Schuckert dynamo, driven by a 60 horse-power twin-engine. Running at 680 revolutions per minute, this machine gives a current equal to 35.9 horse-power. The current is conducted down the shaft to the motor by a copper cable 320 yards in length, consisting of 19 strands of wire each 0.064 inch in diameter, giving a total metallic section of 0.059 square inch. The cable is insulated with gutta-percha and inclosed in a lead pipe. The motor in the mine is also a Schuckert machine, developing a maximum horse-power of 28.8 when running at 700 revolutions per minute. Between the motor and the chain drum intervenes a system of geared wheels, which

reduces the speed down to 10.5 revolutions per minute, giving the chain a velocity of 3.5 feet per second. The dynamo and the motor are both provided with ampere meters having a range of 80 amperes and resistance coils, by means of which starting is effected gradually, and the current afterwards maintained at the working rate.

SIR WILLIAM THOMSON'S COMPASSES.

The House of Lords has given judgment in the appeal by Mr. Francis M. Moore, nautical instrument maker in Dublin and Belfast, against a judgment of the Irish Courts that he had infringed the patent compasses of Sir William Thomson. The Attorney-General, who appealed on behalf of Sir William Thomson, contended that the appellant's second compass card was the same as the respondent's, except that, in place of silk threads connecting the boss with the rim, strips of metal were used, and except also that the magnetic needles were suspended by strips of metal instead of by silk threads, and in vertical and not in horizontal planes. The substitution, however, of metal strips for silk threads, and of vertical for horizontal planes, made no difference in the action of the compass card, and were mere mechanical equivalents for the method of connection of the rim and body and suspension and disposition of the needles described in the respondent's amended specification and drawings, and that the appellant's second compass card, like the respondent's compass card, had very small fractional error, small magnetic needles, and a moment of inertia such as to give it a very long period of free oscillation. Their Lordships gave judgment against the appellant, on the ground that Mr. Moore's compass was substantially a copy of Sir William Thomson's, and that the points of difference between them were of a subsidiary character, and not in any manner essential to the peculiar construction claimed. The appellant had no right to use the respondent's combination for the purpose of improving upon it, or the reverse, as the case might be. The appeal was accordingly dismissed, with costs.

AN ELECTRICAL EXHIBITION FOR PORTLAND, ORE.

The prosperous and growing city of Portland has a fine exhibition building, and now proposes to use it for an electrical exposition. Mr. Z. L. Mitchell, while in the East recently, made arrangements with Mr. Luther Stieringer, who is to furnish plans, etc., and there is already every promise of a brilliant success. We have had an opportunity of seeing the plans, which we find include a number of lighting and structural effects far surpassing those which entranced New Yorkers recently at the Lenox Lyceum. The exhibition will begin early in September.

AN IMPORTANT PATENT SALE.

The United States patents, covering the Widdefield-Bowman automatic electric brake system for freight trains, covered also by patents in Canada, Great Britain, India, Russia, Italy, Spain, Germany, Austria-Hungary and Belgium, were recently sold to the Westinghouse Air Brake Co., of Pittsburgh, for a large amount in cash and royalty. The system, and a test of the same on the Lehigh Valley Railroad, were fully described in THE ELECTRICAL ENGINEER in 1889. Edward P. Thompson, of New York, was interested in the patents as one of the selling agents, and served as attorney in obtaining the U. S. and foreign patents.

PATTISON BROS., ELECTRICAL ENGINEERS AND CONTRACTORS

A new contracting and engineering firm, under the style of Pattison Bros., has been formed at 135-137 Broadway, by Mr. Charles E. Pattison and Mr. Frank A. Pattison, who are prepared to submit and carry out plans on all classes of lighting, power and electric railway work. Mr. C. E. Pattison was for some time associated with Mr. J. H. Vail when the latter was Chief Engineer of the Edison Company, and proved an apt pupil in that excellent school. He did a large amount of work on the big uptown Edison stations, and was also engaged in work in Boston as well as out West. In Boston he put in the underground service of the second Edison district. He was also at one time connected with the old Bergmann Company as electrician. Latterly he was sent to the Argentine Republic to install plants there, and returned only a month or two ago. His brother, Mr. F. A. Pattison, has had charge of the Edison station in New Orleans for the last two years, and is generally familiar with the whole routine of lighting work. The young firm start out, therefore, with ample experience, and may be safely entrusted with work of the greatest magnitude and importance.

NEW ENGLAND TRADE NOTES.

THE JOHN S. PRATT COMPANY, OF HARTFORD, have just built a new factory for the manufacture of vulcabeston, which has been rapidly increasing in favor among electricians for all insulating purposes. The new factory will consist of two buildings, one 100 feet by 40 feet, two stories high, and the other 80 feet by 40 feet, three stories high. Their present factory occupies part of the buildings of the Pratt & Cady Company, and for some time they have been very much cramped owing to the increasing volume of their business, but they will soon have ample facilities for a very large product.

THE PERKINS ELECTRIC LAMP COMPANY, whose headquarters have hitherto been at Hartford, Conn., have removed their office to Manchester, Conn., where their factory is situated. They have increased their capacity now to 4500 lamps per day, and will commence turning out that number this week. Their previous output was 2000 lamps per day, but Mr. J. J. Gates, the secretary of the company, informs me that they were totally unable to keep up with their orders on that number. With the office now at Manchester, they will be better able to handle their rapidly increasing business.

THE WAINWRIGHT MANUFACTURING COMPANY, OF MASSACHUSETTS, have recently increased their business to such an extent that they have found it necessary to increase their manufacturing facilities. They have made arrangements with the Taunton Locomotive Manufacturing Company, at Taunton, Mass., whereby they will materially aid in the manufacture of the well-known Wainwright heaters, condensers, and expansion joints, and will enable the Wainwright Company to carry a large stock of goods, which they have been unable to do owing to an unprecedented demand. Among their recent sales to electric companies are: 800 horse-power heater to the Waltham Gas and Electric Light Company, Waltham, Mass.; this is the third heater supplied to this company. They have also sold a 600 horse-power heater for the electric light plant of the American Waltham Watch Company's factory at Waltham, Mass.

WESTERN TRADE NOTES.

MR. THOS. GRIER, of the National Engineering Bureau, Chicago, has just returned from a trip East, where he has been taking a short vacation. Mr. James Lounsbury, of the Bureau, left Saturday for the East on a short trip to Montreal, Boston and Hartford, where he will combine business and pleasure. He expects to be gone about two weeks.

THE ILLINOIS ELECTRIC MATERIAL CO. are filling numerous orders for poles and pole line supplies and Bishop white core wire and their other specialties. Mr. H. S. Winston, the president and treasurer, has recently made a number of short but very successful business trips, returning from all with his pockets well lined with orders.

J. LANG & CO., 44 Michigan street, the well-known manufacturers of the Lang & Andrew switches, are now making some of these switches for very heavy currents. The workmanship throughout their switches is of the very best, and the copper employed in their construction of the highest conductivity and greatest durability. Heating or arcing in their switches, either large or small, is unknown. They are also just bringing out some very highest class switches for alternating work which contain special features peculiarly adapted for work of this kind.

THE WESTERN POWER CONSTRUCTION CO., 144 Adams street, are getting lots of business and find it difficult to keep pace with their construction work and their large orders for the famous McIntosh & Seymour engines, for which they are the sole Western agents. Mr. Wilson, of the company, has just returned from a flying trip East to the factory at Auburn, where he has been making arrangements for their engine orders to be got out with the greatest possible expedition. Mr. W. P. Adams, the general manager, who is well known and liked all over the country, is flying around all the time and continually catching new business.

THE ELECTRIC MERCHANDISE CO. are receiving inquiries and orders for their electric street railway supplies, to which line they devote their undivided attention, from street railway men all over the country; and although but recently in the field, they are doing a very large business. Supplies of the very best and latest designs for all classes of this work, irrespective of system, can be obtained from this company, and they carry at all times a most complete stock ready for immediate shipment. A fine line of handsome samples of all their goods is to be seen at their store at 11 E. Adams street, and will well repay the electric railway man for a careful inspection.

WM. BARAGWANATH & SON, 48-52 W. Division street, manufacturers of boilers, feed water heaters and purifiers, are at present building a heater which, as compared with those of ordinary size, is a veritable whale. Its dimensions are 5 feet by 22 feet, and when complete it will weigh about 11 tons. In its construction about 4 tons of seamless brass tubing have been employed. Its exhaust ports are 24 inches and its feed pipes 6 inches. Figuring on their basis of rating of one horse-power per foot of heating surface, it will boil the water for 2,110 horse-power capacity of boilers. This enormous heater is being manufactured for the Chicago Edison Company. They are very busy constructing a number of ordinary sized feed water heaters and their other specialties.

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New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.
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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers*

VOL. X. NEW YORK, AUGUST 20, 1890. No. 120

Great as are the triumphs of the present century, we may well believe they are but a forecast of what discovery and invention have in store for mankind.—Lord Rayleigh.

THE ELECTRIC LIGHT AND POWER INDUSTRY.

TEN years ago the electric light was practically and commercially a thing little known in this country. To-day a traveler can go from one end of the land to the other and night after night depend upon no other light than that of electric lamps. In fact there are many places, especially in the South and West, where he will have no choice, but finds electricity to be the only illuminant. This, however, he does not regret. Why should he?

Few industries have sprung into existence attended by such wild speculation as that which beset electric lighting in its early days. The poet with his eye rolling in a fine frenzy was tame compared with some of the geniuses who aspired to fame and fortune as electric light inventors, ten years ago; and the fools who stood ready to follow such will-o'-the-wisps were thicker than August mosquitoes in the Jersey meadows. As a result there was panic and disaster, and for not a short space of time the electric light bore a bad name as an enterprise and a worse repute as an investment. Then came the period of slow revival, patient effort, persistent pushing, and a keen realization of the fact that to succeed the new industry must be based on sound engineering principles and be compacted by honest work from the foundation up. The result is that to-day the industry, product as it is of one decade, compares favorably in every respect with others that have taken fifty years to reach their present maturity and magnitude.

Statistics brought down to the close of the half year ending July, show that the United States has about 1,400 central stations, operating nearly 150,000 arcs and over a million and a half incandescents. The engine capacity of these stations reaches 356,000 h. p.; the boiler capacity is certainly 10 per cent. more. These companies represent a capital of nearly $120,000,000. Yet these figures tell only half the story, for all the incandescent and arc lighting in over 4000 isolated plants has to be added. The gross sum of $300,000,000 would about cover the investment, or a steady expenditure of $30,000,000 annually for ten years. Large as these totals may seem, they are but initial, for the tendency everywhere is to the installation of larger plants, and the necessary capitalization on a larger basis.

If the industry stopped short at lighting it would still be worthy of admiration as one evidence of American enterprise and inventive skill; but it has already annexed to itself and exploited the vast department of electric power, It is unquestionably this field that will see the greatest development during 1890-1900. The electric transportation industry even now segregates itself, but the industrial service of electric power will remain closely allied to that of electric lighting. Already we see the local lighting companies in leading cities like New York, Boston, Chicago, Brooklyn, Philadelphia, Baltimore, Detroit, Cincinnati, San Francisco and others furnishing daily hundreds of horse power of electric current for the most diverse purposes. In New York alone, the delivery of electric power in small units runs from 1200 to 1500 h. p., and is likely to be doubled within a year.

Evidently the situation is one that should fill electrical engineers with courage and hopefulness, and it furnishes the best of reasons for such meetings as that which will be held this week at Cape May. New questions and problems develop daily, and difficulties of all kinds have to be met. Each man has his own experience and his own interpretation of it; but it is not until all have come together in brotherly intercourse and interchange that we have an authoritative utterance, a successful industry and a perfected art.

"Let us rest and be thankful" said an optimistic English statesman as he surveyed the past and the road by which his party had reached its vantage ground. The sentiment is a happy one, but perhaps they of us who are busy in the work of light and power can hardly adopt it to the full. We have good cause to be thankful, but with all the cares and responsibilities of the young and growing industry upon us, we cannot rest yet—except at Cape May.

THE PRODUCTION OF HEAT FROM ELECTRICITY.

IN a recent note appearing in these columns attention was drawn to the existing troubles encountered in the steam distribution system in this city, and the fact dwelt on that the necessity for the existence of such systems was now, to a large extent, a thing of the past, since the introduction of the electric motor solved the question of power distribution in an ideal manner. It was pointed out incidentally at the same time that the only other object fulfilled by the steam distribution, that of heating buildings, was also attracting the notice of far sighted men, and was a point yet to be dealt with by electrical inventors and engineers. While not objecting to the economy attainable by the electric distribution of power over steam, our excellent contemporary, the *Engineering News*, takes us to task for advancing, as it claims, the "electrical radiator" idea, notwithstanding its evident inferiority when compared with the

direct distribution of steam for heating. In proof of its assertion, it enters into a "heat unit" comparison of the two in which it is shown that, as a heat distributor, the efficiency of the electric system is to that of the steam system as 1 is to 11. The calculations given by our contemporary are substantially correct, although no allowance is made for condensation in the street distributing pipes; and hence deserve further notice at our hands in order to make clearer the exact position of electric heating. We think that this can best be shown by drawing a parallel of the course taken by the public with reference to electric lighting. Our contemporary very aptly remarks that the commercial test is the one by which an invention must stand or fall, and it is this very test which has brought electric lighting to the prominent, and we may safely add, dominant, position it occupies at the present time. We need only to recall the scepticism generally expressed by scientific men as to the impossibility of solving the incandescent electric light problem in an economical manner, while not a few among them actually declared impossible what is now of daily occurrence. We need not here enter into the oft recited reasons which have brought about these results, but wish merely to lay stress upon the fact that they still hold true and that the public is constantly demanding improvements in its conveniences and that it is willing to pay liberally for them, while, actually, it pays less and less all the time. We think there can be no question as to the superiority in every respect of electric heating over that of steam, aside from the bare question of economy of generation, and this once demonstrated, all the experience of the past points to the commercial success of electric heating. Our contemporary has taken as an example a case in which a building requires 50 tons of coal per year for its heating alone, and which is, therefore, of sufficient magnitude to warrant the introduction of its own steam heating plant. But it is to the individual householder, burning probably not more than from 15 to 25 tons of coal per year, for all purposes, and not infrequently in a grossly wasteful furnace, that the electric method will appeal most strongly, just as in the distribution of electric power the smaller consumer finds it more economical to employ an electric motor deriving current from a central station, than to generate power directly on the premises.

So far as car heating is concerned, experience has shown that an electric street car can be comfortably heated by the expenditure of 1 h. p. of electric energy. The adoption of the electric heater saves a man at the car house, whose sole duty it has been to look after the stoves and whose wages will buy a considerable amount of coal. The electric heaters do not reduce the seating capacity of the car, as do the coal stoves; and, more important than all, the car is kept clean and free from coal dust, cinders, etc.

Above all, however, we must not lose sight of the fact that the near future may, and will, bring forth some practical method of generating electricity direct from fuel without the intermediary of the steam engine and dynamo, in which case the calculated difference in direct economy between the two systems would largely, if not entirely, disappear. We believe that enough has been said to have justified us in the use of the phrase to which exception has been taken. While fully aware of the factors at present involved in the problem, we can still conscientiously encourage the "electrical radiator" idea. We propose to do so in season and out, as part of our journalistic duty. Nor shall we fail to derive encouragement and argument from the fact that electric heating apparatus is already coming into use, and for various purposes has been found extremely convenient, economical and successful. Apparatus that heats cars, keeps flatirons at the right temperature, cooks griddle cakes, boils eggs, fries bacon, broils steaks, bakes bread and warms beds has certainly reached the practical stage.

IMPROVEMENT IN ARC CARBONS.

Next to the mechanism itself of an arc lamp, the carbon employed is the factor upon which, to a large extent, both the brilliancy and the steadiness of the arc depend. This was recognized very early in the art, and the experiments which have been made to improve arc carbons, would, if collated, fill volumes. Unlike other work in the electrical field, its progress is not closely traceable by the records of the Patent Office, for nearly every experimenter in this direction has chosen to keep his methods and the nature of the ingredients employed to himself. The general nature of the materials used is, of course, well known, consisting for the larger part, at least so far as this country is concerned, in petroleum coke, to which hydrocarbon binding or cementing material is added, such as tar. In Europe gas coke still continues to be the principal ingredient. Attempts were early made, however, to increase the light-giving power of the carbon points by the addition to the carbon mixture of some of the earthy salts, such as magnesium and calcium, which give out a brilliant white light when heated. These additions, however, have invariably introduced accompanying troubles, so that up to the present the pure carbon may be said to still hold the field exclusively. Any dispute which may still exist regarding the nature of carbons has now narrowed itself down to a question of the relative superiority of "forced" or "molded" carbons. But if we are to credit what certainly seem to be well founded statements, an improvement in arc carbons has recently been effected which cannot fail to have its effect on arc lighting generally. This improvement, due to a Mr. Saunderson, as described more fully elsewhere in this issue, consists in feeding into the arc a hydrocarbon oil, which is acted upon and volatilized, and by which the illumination is increased nearly two-fold. The employment of a hydrocarbon as an increaser of the light-giving power for a given consumption of electrical energy certainly removes the objection against the earthy salts. If the new carbons can be furnished at a reasonable cost, such as is claimed to be the case, the slight increase in the rate of consumption during burning ought not to stand in the way of its introduction. As yet the experiments with the new carbon have only been carried out on a small scale, and it is to be hoped that more extended use will warrant the good reports now heard. A thorough investigation of the phenomena accompanying the operation would prove of considerable interest, and we trust the subject will be taken up in a manner similar to the investigation recently submitted by Mr. Louis B. Marks to the American Institute of Electrical Engineers.

LIGHTING THE BRIDEWELL PRISON, CHICAGO.

The Western Electric Company has just finished the installation of an incandescent electric light plant at the House of Correction, Chicago, of about 1,100 lamps. The requirements of this plant are somewhat different from those usually found in electric installations, inasmuch as the institution in which it is placed is a prison, and not only must malicious interference on the part of the prisoners with the apparatus be provided for, but, in dealing with brick walls and steel plates almost entirely, difficulties in the way of construction have been met and successfully overcome that are not usual to such a degree in work of this kind.

Our engraving, Fig. 2, shows a corridor in one of the cell houses of the institution—there being three such cell houses in all. The walls are of brick, 30 feet high, and covered by an iron ceiling. The cells rise four tiers in height, with 40 cells in each tier, and are built of steel plates bolted together, each tier being provided with a gallery of steel with an iron railing running entirely around it. No lights are placed in the cells, as being too exposed to the destructive instincts of the occupants; but the cells are lighted from incandescent lamps placed on the walls in front of the cell doors in vertical rows of four each, the uppermost lamps being 15 inches from the ceiling, and the lowest eight feet from the floor.

To reach these lamps the iron ceiling was pierced and the wires were brought down the walls from above so that they are entirely out of reach of the prisoners.

There are 56 lamps on each wall opposite the cells, and these are under the immediate control of the keeper by means of a single switch in a locked box outside of the cell house door, all out of reach of the prisoners. At each corner of the galleries on each tier is a single lamp at each end, giving the keeper a clear view of its entire length and of the cell doors at all hours of the night, and any movement of the doors, or the presence of any person on the galleries, could be instantly detected.

The wires to the gallery lamps are brought from the iron ceiling through iron pipes to the columns supporting the galleries, and thence distributed at the proper height. These lights are not operated by the switch which controls the wall lights, and which are extinguished at eight o'clock, but burn during the night. In addition, there are the superintendent's residence, the guards' quarters and the kitchens, etc., which are lighted in the usual way. Two Western Electric incandescent dynamos furnish current for the lights, one of 800 light capacity, and one of 300, at 110 volts. The dynamo room is illustrated in the engraving, Fig. 1. The switch-board is so arranged that the dynamos may be operated separately, each with its own load, or singly upon the entire system, or in multiple with the entire load. The dynamos are driven by two Ball engines of 70 and 30 h. p., respectively.

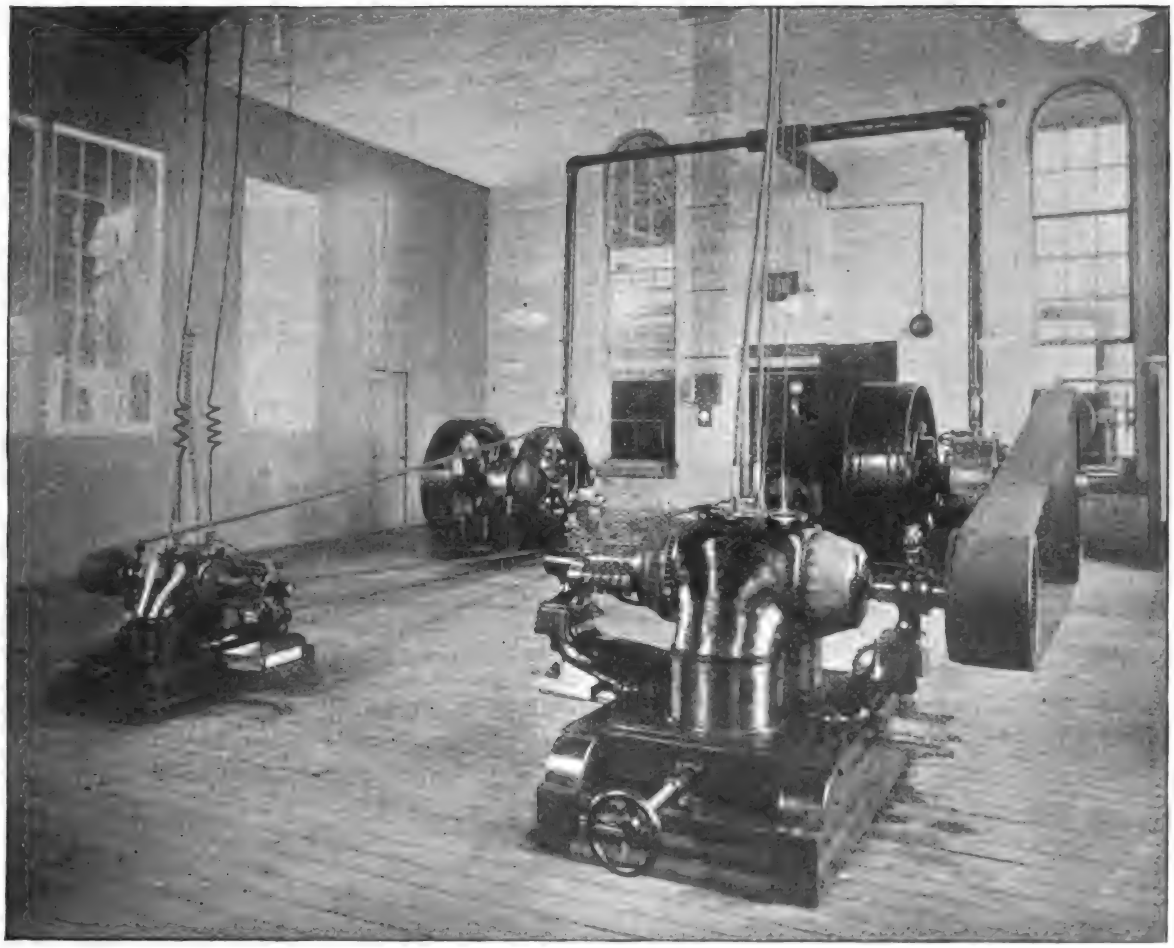


Fig. 1.—Dynamo Room at the Bridewell Prison, Chicago.

Throughout the entire system there is used the Western Electric double-pole multiple cut-out, recently described in these pages, and by means of which lamp circuits may be tested and fuse strips inserted while the current is on the system.

The system is operated throughout the night, and entire dependence is placed upon it for the lighting of the prison.

The illustration, Fig. 2, gives an excellent idea of the manner in which the scheme of illumination above described is carried out. As will be seen, the lamps are placed upon the walls and shine into the cells at a safe distance, being entirely beyond the reach of the prisoners, yet under direct

and immediate control of the keeper, who also has everything in clear view. The advantages gained are such that we need not wonder at the growing favor in which electrical illumination is held for lighting prisons. Another feature, incidental but none the less noteworthy, is the improvement in hygienic conditions obtained with the electric light, whose purity and cheerfulness have been observed to have a marked influence for good on the spirits of those held in durance that ceases to be vile.

A CONTINUOUS CURRENT TRANSFORMER.[1]

THE continuous current transformer at the Chelsea Company's station at Draycott Place, in London, resembles in design an inverted Elwell-Parker dynamo. The armature is of the drum type, the two windings being upon the same core, and a commutator for each is arranged at opposite ends of the armature. The machine has been constructed by the Electric Construction Corporation (Limited), and has given very satisfactory results during the time it has been under test. The output for which the machine is intended is 33,500 watts, and the speed 1,000 revolutions per minute. There is obviously a necessity for extra precaution in insulating the high and low tension circuits from each other in the armature of the transformer, on account of the mechanical stress.

The method adopted by the designers of the machine has been to wind up the primary into thin ebonite troughs, which are laid along on the surface of the armature. This has proved efficient so far. The insulation resistances, which have been steadily rising since the commencement of the tests, is at the time of writing as follows :—

Between the windings, . .	17 megohms.
" the thick wire and frame of machine, . .	7.5 "
" the thin wire and frame of machine, . .	9 "

A test has recently been made of the performance of the transformer, the readings and the results of which are given in the table below :

FIG. 2.—WALL LIGHTING IN THE BRIDEWELL PRISON, CHICAGO.

Record of Tests with Continuous Current Transformer, in London.

	PRIMARY.			SECONDARY.			
	E. M. F. at terminals.	Current.	Watts absorbed.	E. M. F. at terminals.	Curre't	Watts delivered.	Commercial efficiency.
1	604	72.5	43,790	111 5	320	35,536	81.3%
2	606	72.5	43,935	111.5	327	36,316	82.5%
3	588	64	37,632	110.5	280	30,814	82.2%

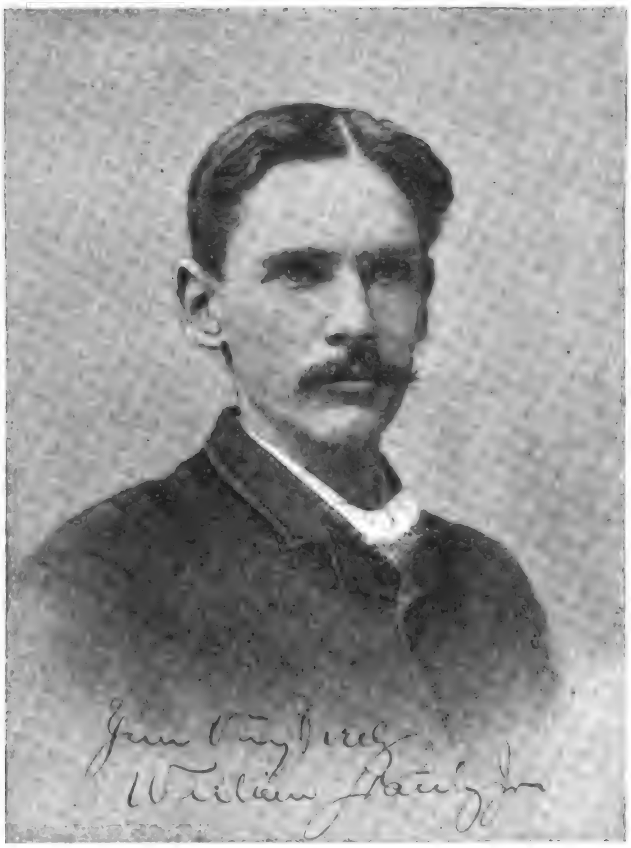
1. London *Electrician*.

ELECTRICAL ENGINEERS.

WILLIAM STANLEY, JR.

Among the young men who have contributed to the development of electrical science in its application of electricity, as an agent of light and power, few have done better work than the subject of this article.

Born in 1858, not yet 32 years old, Mr. Stanley has already a substantial reputation as an inventor and designer of electrical machinery. His tastes were early manifested. When a small boy he had a carpenter's bench and chest of tools and a lathe in his father's attic, and took a single course of drawing lessons; and, with another lad, built and worked a line of telegraph between their houses. Through one of his tutors he became interested in chemistry and in nickel plating by electricity. Still it was not realized that he had a pronounced bent for invention, and he was sent to the Classical School at Easthampton, where he fitted for college. He matriculated as a student at Yale, in 1875, when 17 years of age. Having a strong desire, however, for more active practical work than classical studies afforded, although standing high in his class, he abandoned his college course, and became engaged in a successful nickel plating house in New York city, where he worked with his own hands until he had learned the art practically. He then concluded to cast his fortune in the new born electric light industry. He sold out his interest in his business and engaged as a common laborer in the shops of the United States Electric Light Company, for seven dollars a week. An incident illustrative of his whole life and character soon took him from the workshop into the laboratory and brought him to the notice of the electrician of the company. He learned that Mr. Hiram S. Maxim desired to secure for laboratory use some paper of a special kind for which his agents had been vainly searching among the dealers in New York. Mr. Stanley went to Dalton, Mass., obtained a sample at his own expense, and a few days afterward handed the desired article to Mr. Maxim, much to that gentleman's surprise and gratification.



William Stanley, Jr.

Mr. Stanley was immediately transferred to the laboratory, in which he remained until he voluntarily left the company about 1883, when he was offered and accepted the position of superintendent of the American Electric Co. This position he left to take charge of the Boston Laboratory of the Swan Electric Light Co. While connected with the Swan company, Mr. Stanley made the acquaintance of Mr. George Westinghouse, Jr., an acquaintance which resulted in the subsequent purchase by Mr. Westinghouse of all the inventions theretofore made by Mr. Stanley, upon which basis was founded the now well-known Westinghouse Electric Company, with which Mr. Stanley has been continuously connected since its organization.

Besides doing a large amount of valuable work in designing electrical apparatus and in similar directions, Mr. Stanley has been fertile in inventions, without a mention of some of which any sketch of his life would be incomplete.

In 1883 Mr. Stanley constructed a welding machine with which he electrically welded the terminals of a storage battery he was then constructing to the grid of the plate. He also suggested to the plumbers of Englewood, N. J., that they adopt this process in joining iron and lead pipe for house plumbing.

In 1881 he devised an improved method of exhausting incandescent lamp bulbs; exhausting by a mercurial pump into a vacuum produced by a mechanical pump, thus increasing not only the rapidity with which the pumps can be worked, but also the degree of vacuity obtainable.

Together with Mr. E. P. Thompson, Mr. Stanley devised the method of treating silk thread for the manufacture of incandescent lamp filaments, now in use by the Sawyer-Man Company. Previously the manufacture of carbon filaments from materials containing nitrogen compounds, such as silk, had been difficult, owing to the fact that the silk would melt when heated below the carbonizing temperature. By removing a portion of the nitrogen compounds from the thread they found that a filament was produced having a condition resembling unstable equilibrium of the atoms, which could be carbonized at a temperature as low as 125° F. Some of these silk carbon lamps at the Electrical Exhibition, at Philadelphia in 1884, showed, during life, the highest efficiency of any lamps exhibited.

During the year 1884 and a part of 1885 Mr. Stanley was engaged in experimental work in the shops of the Union Switch and Signal Company, Pittsburgh. In October, 1885, he removed on account of his health to Great Barrington, Mass., where he built and equipped a complete laboratory for experimental work. During these years he first designed the form of induction coil, or, as first called by him "converter," of the type now largely used in this country. He also developed the self-regulating system of alternate current distribution now in use by the Westinghouse Electric Co. Having observed some apparatus of the Gaulard & Gibbs system, imported by the Westinghouse Co. in the spring of 1885, he ascertained its defects, and determined that the best system of distribution by converters involved the use of an alternate current generator, giving a current of constant potential and high E. M. F. with converters connected in multiple arc, the converters being constructed in such a way that practically no current should traverse the primary circuit when the secondary circuit was open, and also so organized as to allow current to flow through the primary circuit in direct proportion to the current abstracted from the secondary circuit, to the end that the current produced by the dynamo should always be proportionate, and equal, to the current used in the consumption circuit. In order to demonstrate the practicability of his system, Mr. Stanley equipped and put in operation in the spring of 1886, in the village of Great Barrington, a practically operative lighting plant, which may be fairly said to have been the first successful alter-

nate current electric lighting plant in this country. All the apparatus was made at his laboratory in Great Barrington, and though crude in finish produced good results. The system was at once adopted by the Westinghouse Company, the first commercial plant being put in operation at Buffalo, N. Y. on Thanksgiving Day, 1886.

In connection with the operation of the Great Barrington plant, Mr. Stanley constructed a regulator for the dynamo, the mechanism of which was controlled by a repulsion dynamometer, operating upon the principle of repulsion explained by Prof. Elihu Thomson in his lectures, and explained and illustrated at length in a recent article by Prof. Fleming. This dynamometer was the first piece of apparatus constructed operating upon this principle.

Perhaps no one of Mr. Stanley's inventions has excited more general interest from both a scientific and a practical point of view than his self-regulating constant current dynamo especially adapted for alternating current arc light systems. In this machine the regulative effects are produced, not by any pronounced departure in constructive details from well known forms of dynamos, but by such proportioning of the parts that, whatever the resistance in the external circuit, an electromotive force will be developed sufficient to maintain an approximately constant current value. One of the fundamental principles underlying the operation of the machine is that the magnetic conductivity of the magnetic circuit provided for the field lines of force, and consequently the effective value of the field lines of force, is varied by opposing the magnetic potential of the field with a counter magnetic potential, due to the armature current, and varying with variations in the resistance of the work circuit.

The fruits of Mr. Stanley's restless energy in the field of invention have been so numerous that full mention even of those of considerable importance is impossible here. While he seems sometimes to solve electrical problems almost intuitively, his success in this field of work is chiefly due to his power of intense and energetic application to the work in hand, a quality which has won for him a degree of success seldom secured by so young a man.

AN ELECTRIC COAL MINING EQUIPMENT.

In our last issue we gave a description of the highly interesting electric plant recently put in operation in the First Pool Monongahela Gas Coal Co.'s mines at Willock Station, Pa. This electric equipment was designed and installed by the Mill and Mine Electric Equipment Co., of Pittsburgh, Pa., under the supervision of Mr. W. A. Giles general manager and electrical engineer for the company, to whom we are indebted for further interesting particulars regarding the plant.

The power plant consists of two 12x20 Carter engines and one 30 h. p. 3-wire, 4-pole Westinghouse self-exciting, alternating generator. All switches, meters, etc., are mounted on a switchboard in most convenient location to be easily handled. The voltage on the main line is about 300 volts. Inserted in the main line at convenient locations are several specially designed mine switches with safety catch attachments, and all switches used in these mines are so designed that no metallic part is exposed. All wood work of the switches is made thoroughly waterproof and the switch handle is detachable and carried by the motor man. This prevents the switch being tampered with by meddlesome persons.

The wire used in these mines is all of the Clark rubber-covered special mine finish type, and all wire connections are made with McIntire connectors. All wood work is made waterproof with P. & B. compound. The coal cutting motors in the rooms are connected to the main line by a specially made insulated flexible cable, which can be coiled on a special reel and taken to another room in a few minutes. This cable when in use is supported by glass hook insulators made for this purpose.

Six "Hercules" coal mining machines, with 3 h. p. Tesla motors mounted thereon, as shown in the engraving, Fig. 2, are now in operation in these mines. The machine and motor complete weighs about 1,000 pounds and is easily handled and shifted from room to room by one man. A specially designed truck is used in conveying machine from one room to another. These machines, by means of a set of gang bits or augers, make an undercut 3 inches high, 36 inches wide by 42 inches deep. One man with this machine will average 40 cuts, or about 43 tons of clean cut coal in 10 hours. This is equal to the product of 12 to 14 pick miners.

The ventilating outfit in this mine consists of a 12 ft. Pollock fan, with a capacity of 30,000 cubic feet per minute. It is situated at the bottom of a shaft 75 feet deep, and is so arranged that the fan can be changed from an exhaust to a blower in 5 minutes. This fan is also run with a 3 h. p. Tesla motor.

The pumping outfit consists of a centrifugal pump of a capacity of 90 gallons per minute, mounted on the same truck with 3 h. p. Tesla motor and connected to the same by means of a belt, as shown in Fig. 1. This pump and motor can be taken to any part of mine and connected to the power line in a few minutes.

These mines have an incandescent electric light plant, consisting of a United States 300-volt, automatic incandescent dynamo, running 150 Sawyer-Man lamps, mounted in special waterproof mine sockets with rubber insulating joints. These lamps are connected in loops of three in series across the main circuit, and placed along the main entry at a distance of 80 to 90 feet, and three 16 c. p. lamps are placed in each room. This gives perfectly satisfactory illumination and demonstrates the great importance of better light in coal mines.

The following record shows the large amount of work which can be accomplished with but a few machines. Indeed it has been demonstrated that they can work faster than the rooms can be cleaned up of the coal which is brought down. The record, which is taken from the company's books, extends from July 1 to Aug. 8, and each cut represents about $1\frac{1}{10}$ ton of nut coal.

	No. of Machines at Work.	No. of Cuts Made.	No. of Machine-Hours Run.
July 1.	5	113	35½
" 2.	4	119	34½
" 3.	4	107	29
" 7.	4	117	32½
" 8.	4	109	31
" 9.	4	140	37
" 10.	4	127	34½
" 11.	4	134	35½
" 12.	4	135	35½
" 14.	4	130	35
" 15.	4	134	36½
" 16.	4	134	36
" 17.	4	140	38
" 18.	3	55	14
" 19.	3	31	8
" 21.	3	69	17
" 22.	4	80	20½
" 23.	4	101	29
" 24.	4	134	36
" 25.	4	69	19
" 26.	3	45	12½
" 28.	4	124	35½
" 29.	4	103	28½
" 30.	4	75	21
" 31.	3	55	16½
Aug. 1.	4	118	30½
" 2	4	124	33½
" 5.	4	116	35½
" 6.	4	127	34
" 7	4	141	36
" 8.	4	130	38

The Mill and Mine Electric Equipment Co. is now putting

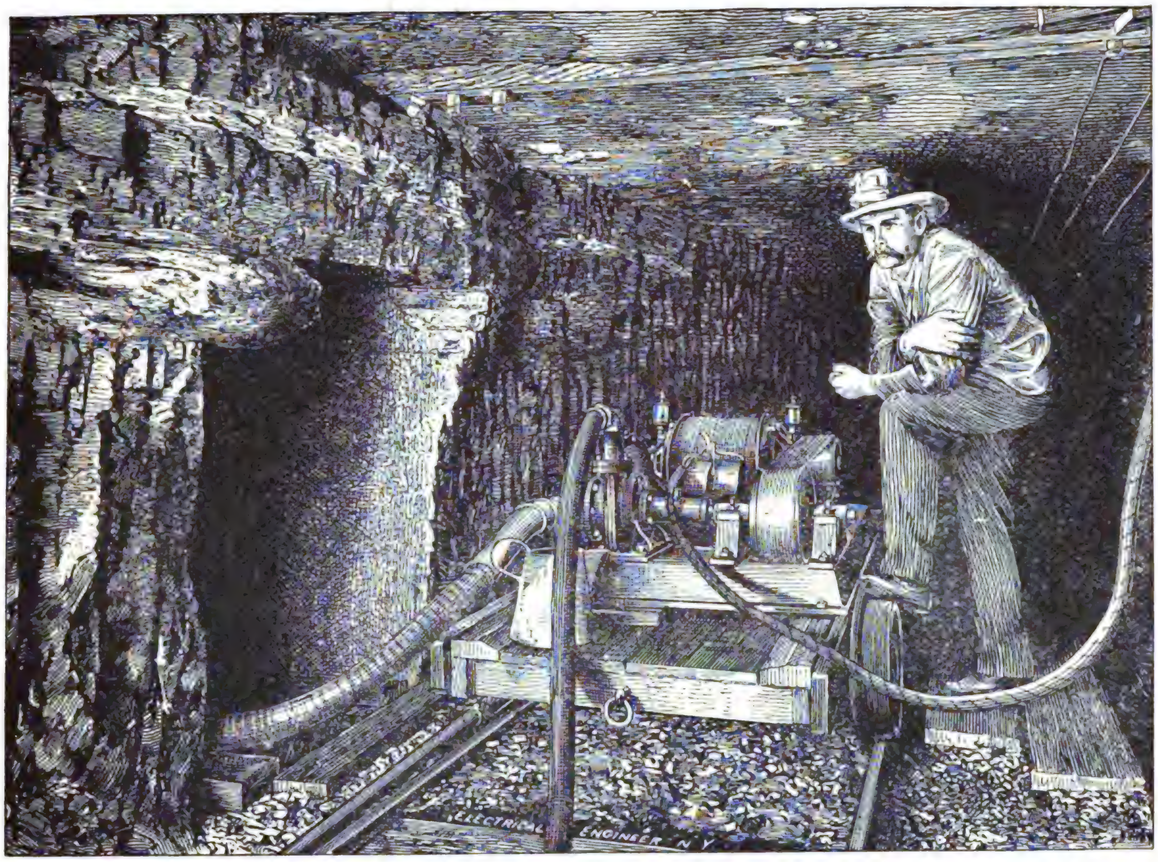


FIG. 1.—TESLA MOTOR DRIVING CENTRIFUGAL PUMP, WILLOCK COAL MINE.

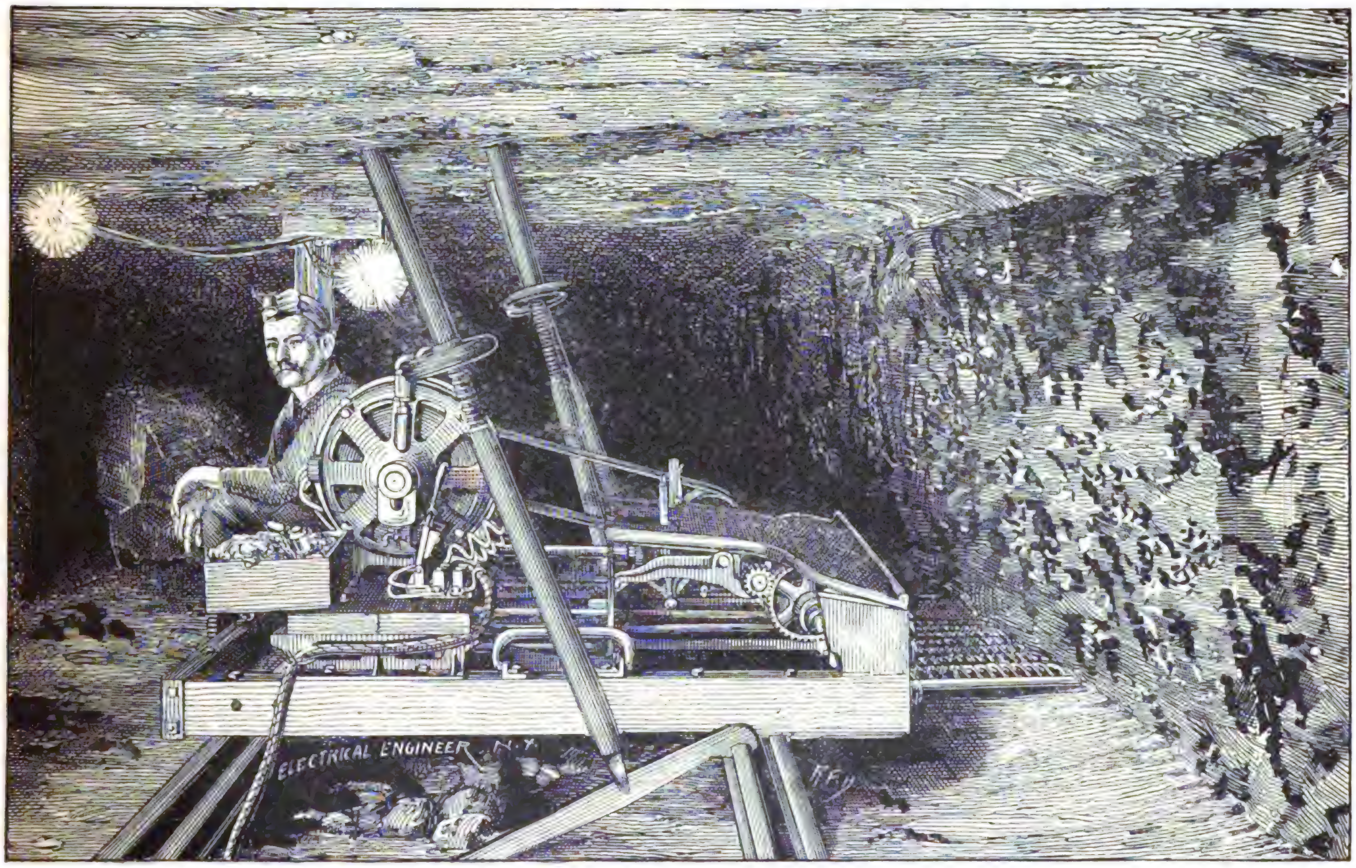


FIG. 2.—TESLA MOTOR DRIVING HERCULES COAL MINING MACHINE.

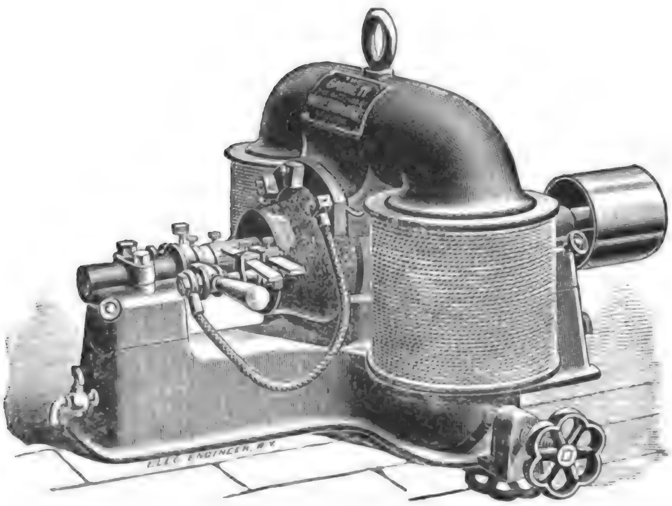
a similar equipment in Mr. Frank Armstrong's Summer Hill mines at Woodville, Pa. This company has done considerable of this work, and has on hand several orders for electrical mill and mine outfits. It has also designed a special electric mine locomotive and sparkless signal system, which is very essential in gaseous mines.

THE BARRIETT MOTORS.

For some time past Mr. S. L. Barriett, electrician of the New York Electrical Manufacturing Co., recently organized by Mr. A. Noll, has been engaged on the designing of various sizes of electric motors, the manufacture of which has now been actively undertaken and which embody a a number of novel features worthy of description.

Beginning with the large machines, Mr. Barriett has chosen the design shown in the accompanying engraving, consisting of a consequent pole field having wrought iron cores with cast iron yoke piece and base. The core of the armature is built up of annealed charcoal Norway iron discs, which are first rumbled, in order to remove the scale and to get rid of the sharp corners left by the stamping process. One sheet of insulating paper is placed between adjoining plates and two sheets at every fifth plate.

In order to make the magnetic circuit as perfect as possible, the joints between the field cores and the yoke



The Barriett Motor.

pieces and base are scraped so as to bring the metallic surfaces in absolute contact over the entire area. This, of course, reduces the resistance of the magnetic circuit considerably, as is shown by the high efficiency obtained in the machine.

The armature discs are not mounted directly upon the shaft, but upon a hardwood sleeve which is run over the shaft, and the armature discs clamped by end plates having teeth for the guidance of the armature wires and in order to retain them in position. The spindle is left rough until the discs are all mounted upon it and screwed up, after which it is turned down true to a B. & S. plug gauge.

Mr. Barriett is a thorough believer in securing perfect running balance for all revolving parts, and hence has devoted special care to this consideration. Thus, in the first place, the core, when mounted upon the spindle, is balanced without the winding upon it, but with the pulley mounted at the end of the spindle. The latter is also finished all over in order to obtain perfect balance. The armature is then wound and balanced again, the final balance being obtained by the solder on the holding-on bands.

Thorough lubrication has also been provided for in a very ingenious way. Situated below each bearing is a large reservoir, which is filled with oil. Supported in loose bearings in this reservoir are two circular iron discs which dip into the oil, and are attracted to the spindle by magnetic action. As the spindle revolves the discs constantly turn with it, bringing a continual fresh supply of oil to the bearings. A single filling of the reservoir suffices to lubricate the bearings for weeks without any attention whatever.

The machines of this type manufactured by the company range in size from $\frac{1}{8}$ h. p. up to 10 h. p., and in order to show the extent to which the material is utilized, we give below the details of the construction of the 1 h. p. Barriett motor designed to run at 220 volts:

Resistance of Armature, - -	.8 ohm
" " Field - -	430 ohms
Diameter of Armature, - -	5 inches.
" " Field cores - - -	$3\frac{1}{8}$ "
Length of Armature Core, - -	$5\frac{3}{8}$ "
" " Field " - -	5 "

The armature is wound with 60 sections of No. 21 B. & S. G. wire, with 28 turns to each section, and there are 30 segments in the commutator. The field is wound with No. 23 B. & S. G. wire, having a resistance of 430 ohms and with 7,990 turns on each leg. The motor runs at 1,850 revolutions per minute, and the pulley is $4\frac{1}{8}$ inches in diameter.

Mr. Barriett has also designed a very compact little fan motor, which has a magnetic circuit energized by a single field winding, and built up of laminated sheet iron baked in Japan varnish. The little motor is series wound, the armature having a resistance of 5 ohms and the field 400 ohms. Thus, when running at the full speed of 1,650 revolutions on a 110 volt circuit, the motor only takes one-sixteenth of an ampere. The work accomplished by the little motor is certainly astonishing, and the noise and vibration has been reduced to a minimum by shaping the fan blades in true helicoidal form, in exact imitation of a screw propeller.

These pigmies, as well as the machines of the larger type built by Mr. Barriett, are all made with interchangeable parts throughout, even the commutator on the smallest fan motor being made by standard machinery designed by Mr. Barriett for that purpose. The results obtained thereby are extremely satisfactory, resulting in a uniform product of the highest excellence.

THE OKONITE FACTORY AT PASSAIC, N. J.

Among the materials in use in electrical engineering work a leading place must unquestionably be given to the conductors employed. The best work in any direction, whether it be a dynamo, motor or any other piece of electrical apparatus, must to a large extent be affected if the conductor employed to connect one apparatus with another is defective. In the progress which has been effected in the construction of electrical apparatus generally within the last few years, that pertaining to the manufacture of electric wire and conductors of all kinds has not lagged behind. Indeed the result obtained within that period may be said to be little short of a revolution so far as the industry is concerned in this country. Not that good wire was not made before this period of great activity, but unfortunately it was not employed to the extent to which it was desirable to use it, with the result that frequent losses and other inconveniences were experienced, which, with good conductors, would never have occurred. Gradually, however, the consumers of wire began to realize the importance of employing wire having good insulation, with a result that the demand for this class of goods has reached proportions which are now scarcely realized, and the effect of which is to have built up an enormous industry, which is constantly on the increase.

Among the insulated conductors that have deservedly won a high reputation is that manufactured by the Okonite

Company, of this city, and we propose in the following to give a brief description of the methods employed by them. The works of this company are situated at Passaic, N. J., and as power is not an inconsiderable item in the cost of manufacture of any apparatus, the company have wisely situated their factory in close proximity to a large water power, which has thus far been unfailing in its supply for many years. The factory at this date is a three-story brick building, 380 x 60 feet, with a wing 70 x 120 feet, and engine and boiler room, 80 x 60 feet, adjoining. There are also carpenter, machine and blacksmith shops on the premises. The entire group of buildings and plant cover an area of about six acres; 400 hands or more are employed, turning out about 60 miles of insulated wire per day. Water power, as stated above, is used for driving the machinery. This is furnished by the Dundee Canal, on which the factory is situated, but in case this should be unavailable from any cause, a steam engine of 250 horse-power capacity proves an efficient substitute. In the engine-room is also a 50 horse-power Thomson-Houston dynamo, used in connection with the incandescent lights with which the factory is supplied.

FIG. 2.—TESTING ROOM IN THE OKONITE FACTORY.

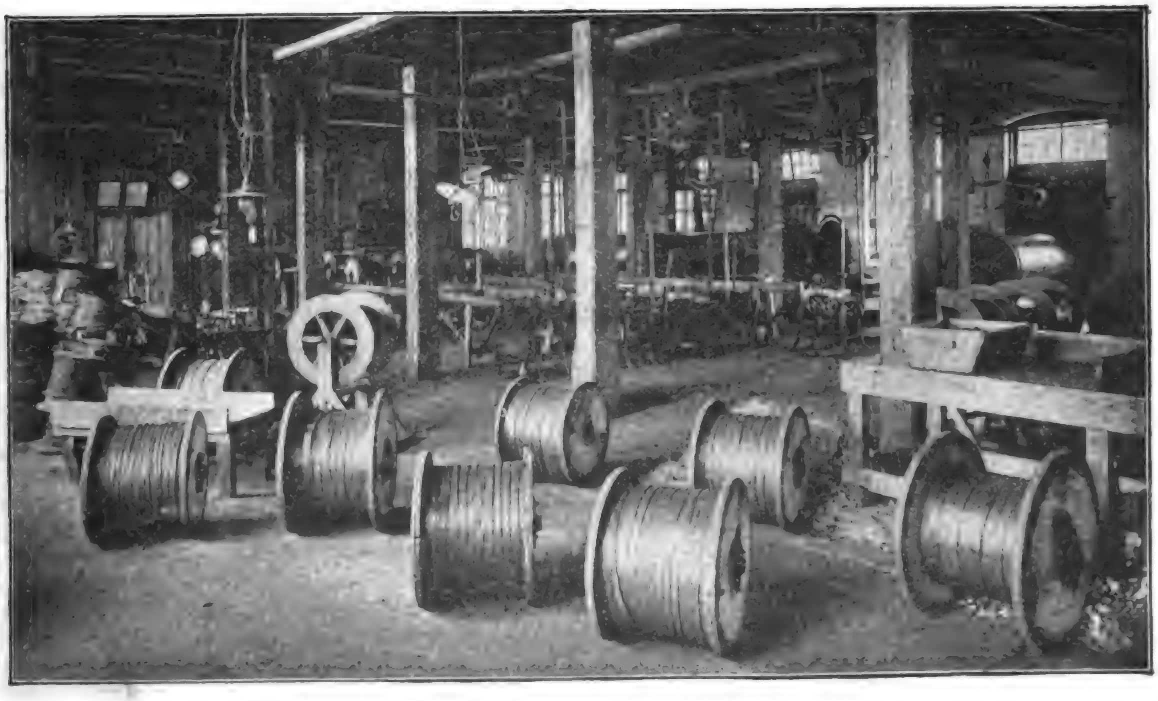


FIG. 1.—WIRE COVERING ROOM IN THE OKONITE FACTORY.

Proceeding now to the manner in which the wire is prepared, the first step necessary is to thoroughly clean the

surface of the copper and to tin it; for this purpose the wire is passed through a pickling bath and then through another of tin, which gives it a bright, smooth surface. The tinning, as is well known, is done to prevent the corrosion of the copper, which would reduce its effective cross-section when exposed to the air and moisture. When thus prepared it is ready for the application of the insulating material.

In applying this to the conductors the Okonite Co. pursue a unique process, which they claim insures perfection of insulation. Contrary to the usual method of what is known as "squirting," that is, passing the conductors through a templet and forcing the insulating material about it, the company employ the following method: The okonite material, which consists of a mixture of pure rubber with other ingredients, is rolled out into thin sheets exactly the thickness of the insulation required. This is then placed on wide strips of tinfoil and then cut into strips of a width sufficient to cover the wire of a given size. It is rolled on large reels in the form of a tape and passes to the next process, which consists in applying this tape to the wire. The accompanying engraving, Fig. 1, shows a scene in the room in which the tape is so applied to the conductor. The wire, guided by means of a templet, is surrounded by the

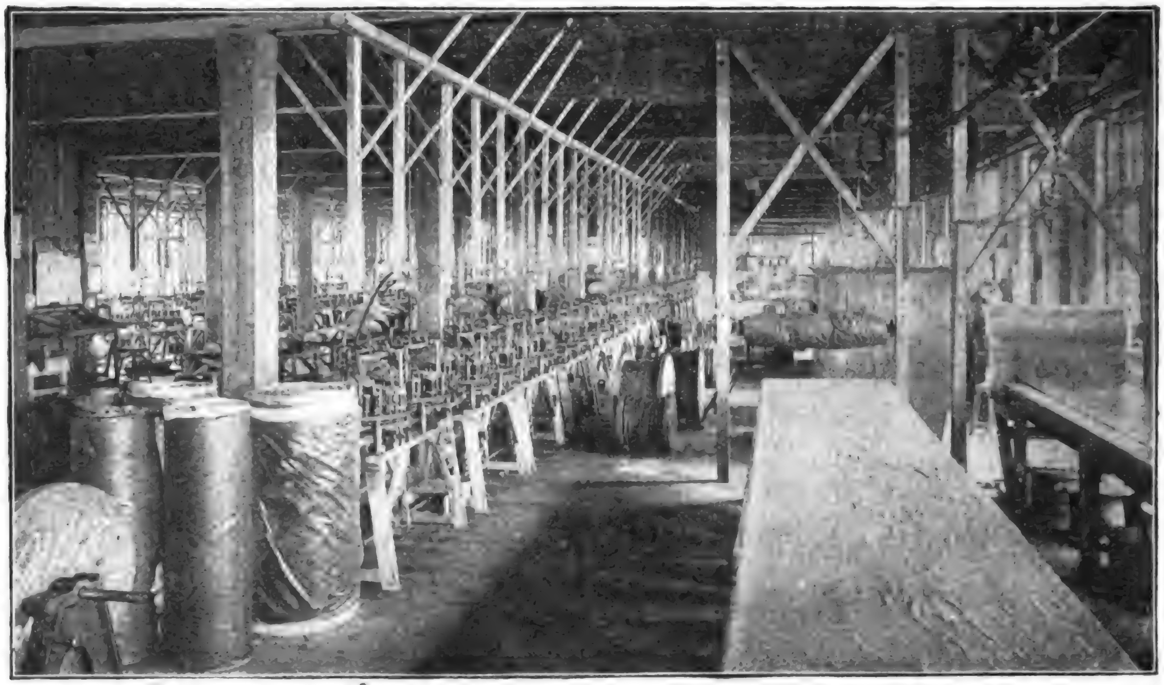


FIG 3.—BRAIDING ROOM IN THE OKONITE FACTORY.

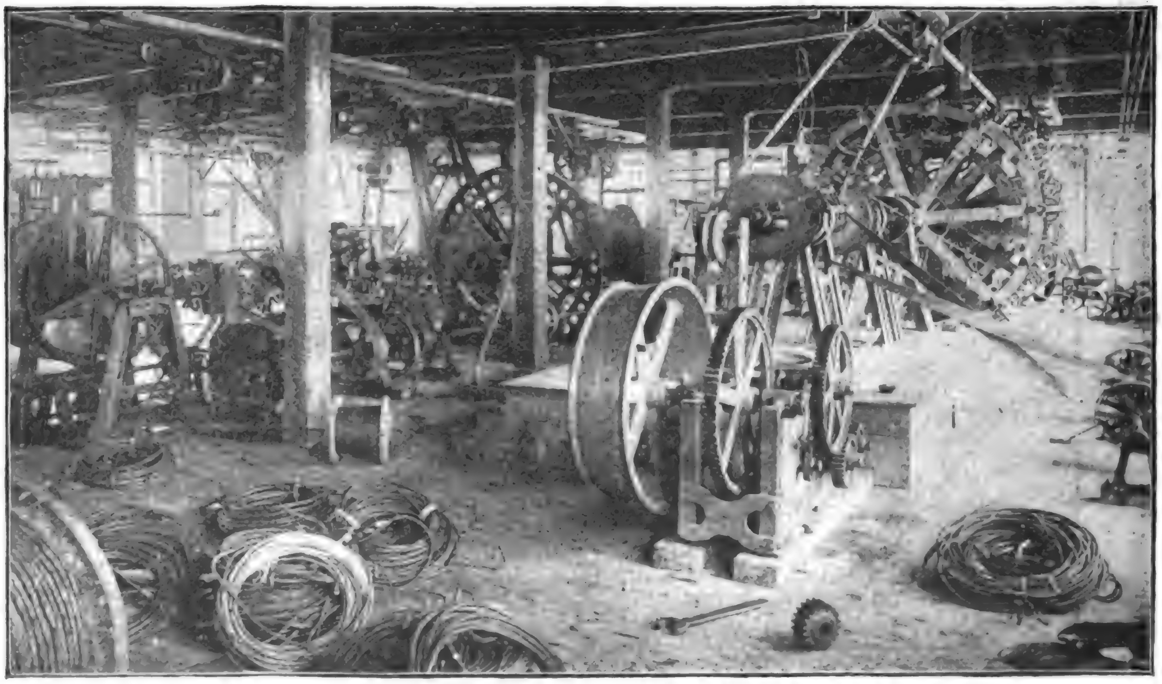


FIG. 4.—CABLING AND ARMORING ROOM IN THE OKONITE FACTORY.

tape, which is molded around it, leaving the burr on the edge which is so characteristic of okonite conductors. In this condition the foil-covered and insulated conductor is rolled up on large reels and placed in vulcanizers, where it is subjected to a temperature of over 300° F. These reels are kept constantly revolving, so that the wire may not settle down and displace the insulation, as would be the case if the wire were allowed to remain stationary in the vulcanizer. After remaining in the latter for the required time, the foil-covered wire is taken out and the foil stripped off, leaving the insulation exposed. The stripping process is accomplished at very great speed. In order to insure integrity in the insulation of the wire, it is, of course, necessary to test every piece before it is allowed to go out of the factory, and indeed the system of the company is such that a continual record is kept of every length of wire from the first to the last operation, so that any trouble which may occur can be directly traced to its source, and each handling must be accounted for by those in whose charge it is. After the wire has been insulated, it is placed in the testing tanks connected with the testing room, which is illustrated in the engraving, Fig. 2. Here the testing is carried on by means of four Thomson galvanometers and any faults located are noted. The methods of finding faults employed in the factory are very interesting. Of course a series of galvanometer tests might show and give an approximate indication of the location of the fault, which may only be a very slight leak; but as this would require some time, the method is employed of developing the fault so that it can be located very quickly. For this purpose, as soon as a fault is detected in a coil or reel of wire, it is placed in a special tank filled with water, one end being connected with the terminal of a dynamo developing an electromotive force of 2000 volts, and the circuit being closed to the other terminal by means of a plate immersed in the tank. The instant that the circuit is closed a flash occurs at the defective spot in the wire, and the insulation is burned out at that point. With the fault thus thoroughly developed, the coil is placed in circuit with a "buzzer" arrangement as a detector. The man in charge, by manipulating the various convolutions of the coil, by submerging and drawing them out of the water, is able to pick out the faulty convolution in the fraction of a minute, and the weak spot is at once located by the burn-out, which is always quite marked.

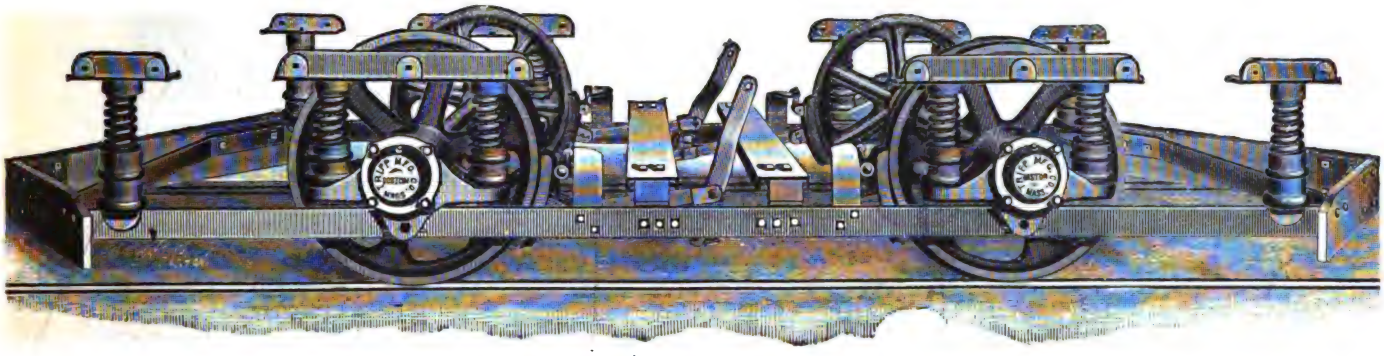
After the wire has been thoroughly tested, the next process it undergoes is that of braiding. This operation is performed in the room illustrated in the engraving, Fig. 3, a large number of machines being in operation in the factory for that purpose.

As is well known, the Okonite Company also manufacture cables for all electrical purposes and are equipped thoroughly with cabling and armoring machines. Several of these are employed, a few of them being shown in the engraving, Fig. 4. At the works there is also in constant operation a Thomson welding machine, by which all joints in the wires are made. The works are also lighted by the Thomson-Houston dynamo of 450 lamps capacity, which is the only illumination employed on the premises. The company do not employ coal as a fuel, but have arranged their own oil burning plant, which has given great satisfaction. The steam required is that employed for the use of the vulcanizers, since, as stated above, the water power is sufficient for the power required. Besides the insulated conductors of the highest grade manufactured by the company at the works, the Candee line wire is also made here and the Manson tape. The Candee line wire is first covered with insulating compound, then taped, then braided, and finally soaked in weather-proofing insulating material.

The works are under the supervision of Mr. F. Cazenove Jones, superintendent, with Mr. Christ. Klotzbach, assistant superintendent. As recently announced by us, the Okonite Company have lately made very influential English connections, and a branch factory for the manufacture of Okonite conductors is now being equipped in Manchester, England, which will be planned after the American works.

THE NEW STANDARD TRIPP ELECTRIC RAILWAY TRUCK.

The advent of the electric car and the suddenness with which it has sprung into favor have induced car builders to make large improvements in the form of truck, and among those who have devoted special attention to this branch are the Tripp Manufacturing Co., of Boston, whose latest and most improved form of truck we illustrate in the accompanying engraving.



The New Tripp Electric Railway Truck.

This truck is made for 14, 16 or 18 foot cars, with, or without, the extension springs shown in the engraving, which are designed to prevent oscillation of the car. For the largest car a bottom truss is used from end to end of the equalizing bar and bolted to it by four vertical supports. As will be seen, the equalizing bar is perfectly straight, and quite unlike the form now generally employed, which usually bends up over the journal boxes. The boxes in this case are simply bolted with steel pins through a lug on the box to the equalizing bar, which makes it extremely easy to lift the car from the wheels. All that has to be done is to jack up the car, take out the four bolts, and run out the wheels.

The Tripp trucks are noteworthy, not only on account of the Tripp anti-friction bearings with which they are fitted, saving a very large amount of power, but on account of their extreme simplicity, there being very few parts, and a minimum of bolts. They are being widely adopted all over the country by electric railroads, especially in the West, where the dust-proof bearings are proving very valuable. The saving in power effected is also an important feature in the West, owing to the high price of fuel. A large number of these trucks are now being placed in Van Couver, Seattle, and all along the Pacific coast, where a thoroughly well constructed and elastic truck is required, as the road-beds are not, as a rule, as good as in the East.

THE CROCKER-WHEELER PERFECTED MOTORS.

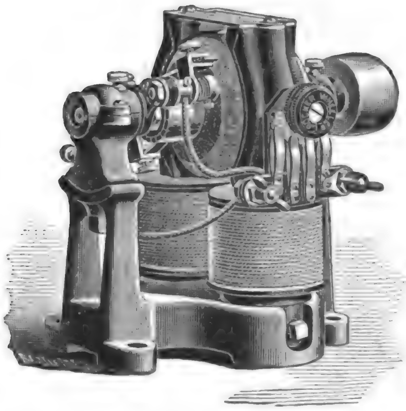
BY DR. S. S. WHEELER.

The type of machine now being constructed by the Crocker-Wheeler Motor Co. has been adopted after a long series of experiments, and is believed to be the best possible form for a perfect motor. It is the combination of a number of ideas with which we have long been impressed as being vitally necessary in the construction of perfect motors for practical work.

Believing that much of the expense usually incurred in placing motors upon the market might be saved if more attention were paid to what might be called the expensive construction of machinery in order that its operation should be cheap, and if machines were built heavier and stronger, they would obtain a much better footing with the public than could be secured by any other means.

Among the features which we have considered in need of special care are, the heating of motors, due to overcrowding with current, the want of attention to lubrication of the bearings, the imperfect insulation of the iron parts of the machine, the elimination of end thrust, the increase of contact surface of the field yoke, the removal of "armature support" from between it and the commutator, and the doing away with the probability of accidental grounds, and many other features.

We believe we have produced a series of motors which



The Crocker-Wheeler Perfected Motor.

are not only improved in all these respects, but which, being so improved, are practically perfect. The smallest of this series (1/6 h. p.) of which a view is presented in the accompanying engraving, is perhaps the most interesting on account of its extremely small size, and the fact that it embodies all of the new features alluded to. This motor gives its full power at 1,800 revolutions, with a weight of 25 lbs., and at an efficiency of 72 per cent. The magnetic circuit is of equal carrying capacity all around, the forged cores being set into a cast iron base to a depth sufficient to give a cross section in the cast iron enough greater than that of the wrought iron to make up for its inferior magnetic capacity.

The pillow blocks, which are of the self-centered style made to fasten with one bolt, carry bearings provided with universal ball joints for easy alignment, and self-oiling ring attachments. These rings, traveling upon the shaft, carry oil up continuously from the oil wells in the lower part of the pillow block. The use of self-oiling bearings has never before been attempted in small motors, but there can be little doubt that, in this particular, our advocacy of perfect construction for even the smallest motor is most important. The smaller a motor, the more likely is it to be put up anywhere—on a bracket—and neglected; therefore the importance of self-oiling devices is obvious. Fresh oil is supplied in these reservoirs every two weeks, instead of daily, as is usually required, by drawing off the old oil. This is accomplished by first removing the thumb screw from the opening at the base of the pillow block, and then putting in fresh oil at the upper opening.

The armature is mounted on a face plate on one side only, thereby freeing the commutator and its connections from any possibility of accidental grounding against an inside supporting spider. The armature and its connections are entirely covered, as in larger sizes, to keep out metallic dust, etc. The brushes are supported on a rocker arm and are held in small brush holders, provided with adjustable steel tension springs, and the direction of rotation of the motor may be reversed by shifting the rocker arm and reversing the brush holders. The rocker arm may be rotated the entire 360 degrees, a sufficient space being left around the bearings to clear the nuts on the ends of the brush rods and the flexible cable connections, so that in no position of the brush fittings could any accidental contact occur. The armature core reaches close to the inside of the pole pieces, and, being of the same width as the latter, holds the armature centralized by its magnetic attraction and relieves the shaft of all end thrust; in fact while it is thus held without friction, it is held so powerfully that it is not disturbed by the thrust of a large fan attached to the shaft.

These machines are wound for any number of amperes or any number of volts; those wound for incandescent circuits being of three classes: "Plain series" for steady work, such as driving fans and pumps; "plain shunt," for variable work, which requires that the motor itself maintain steady speed automatically; and "series with double speed," used for running fans and other work at either slow or high speed. The controlling switch is attached to one of the pole pieces directly over the field coil, so that all of the connections are made directly from beneath. In the case of the "shunt" machines, a starting coil for the armature is wound upon the nearest leg of the field, and is so connected that when the armature current passes through it in starting, it tends to strengthen the field.

The outside dimensions of the machine are $9\frac{1}{2} \times 8\frac{1}{2} \times 6\frac{1}{2}$ inches; diameter of shaft, 3/8 inch; revolution of constant speed machine 1,800, or as slow as 1,000 when required.

"AJAX" CENTRAL STATION AND POWER SWITCHES

BY C. S. VAN NUIS.

Since the general adoption of electricity for transmitting power to great distances, for the operation of street railways, mills, mines and other industries, electricians have given their energies to the task of designing reliable apparatus for the generation, control and manipulation of the necessarily heavy currents at greatly increased potentials.

Modified forms of the already familiar generators and motors have shown themselves efficient in the new field; improved line wire and insulators have had the desired effect of increasing the insulation of long circuits; current indicating apparatus has had a share of thought and attention, and a corresponding advance has been made in that part of the station outfit.

In the line of progression, and in response to the demand for a better station switch, suitable in design for any current capacity at any potential, and which should be reliable under all conditions, the conception of the principle of the "Ajax" switch was formed.

Probably the first requisite in any switch should be ample current-carrying capacity. This can be obtained by using sufficient metal of good conductivity, and securing good, rigid contact surfaces.

Next in importance to carrying capacity should be the breaking capacity. If it is important to have a snap movement in an incandescent lamp socket, where one-half ampere of current is used, it surely ought to be essential in a larger switch. How often have we seen well proportioned switches blackened and blistered, sufficiently to impair their usefulness, because, in an emergency, or a

moment of careless forgetfulness, an attendant had opened the circuit at that point while a partial or full load of current was passing Many-slow motion station-switches are placed where it is predetermined that no current shall be flowing when the circuit is opened, yet the emergency comes, sooner or later, and the result is as described.

The "Ajax" switches are made of metal of high conductivity, properly proportioned and finished, so as to secure a maximum carrying capacity for a minimum amount of metal, and, being mounted on slate bases, they are practically indestructible from any reasonable overload. The new carrier and spring causes an instantaneous break across two or more long lines of contact, simultaneously, which movement is entirely uncontrolled by the hand of the operator, and eliminates burning of the points of contact, when called upon to open, or break, its maximum load or a short circuit. Hence it would appear to be thoroughly reliable in the hands of the most ignorant, and wholly indestructible in any use for which it is intended.

The accompanying engraving, Fig. 1, illustrates a station dynamo switch of 200 amperes capacity designed for single trolley railway work. As will be seen, the snap movement is obtained by the employment of a hollow slotted carrier, pivoted on the same bolt on which is hung the cast

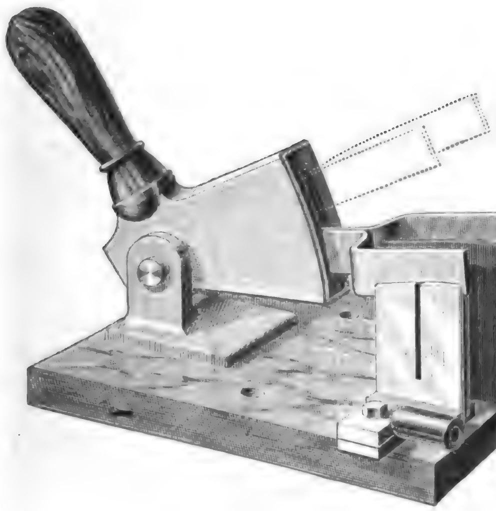


Fig. 1.—The "Ajax" Double Pole Switch.

tongue, which supports the current-carrying blade. Within this hollow carrier is a flat leaf spring, with one extremity extending into the handle and fastened there, while the other bears directly on the lower end of an extension of the cast tongue. When the handle is pressed backward the carrier moves in a vertical plane, while the contact clips hold the blade and tongue stationary until the stop at the lower end of the slot in the carrier bears on the tongue; then all raise together.

While the tongue remains stationary, the moving carrier exerts a pressure on the spring, which is sufficient to overcome the friction of the clips on the blade before the latter quite reaches the top, so that an exceedingly rapid movement is acquired at the lines of breaking contact, independent of the movement of the handle by the operator. The current-carrying blade is so bent and placed in all of the high potential switches of the "Ajax" type, as to admit of an insulating screen being placed between the clips, which engage the extremities of the blade, thus obviating the possibility of an arc between the contacts when the circuit is opened. A flat spring, composed of two or more leaves, was selected for these switches as the type combining the greatest elasticity with longest life.

For currents not exceeding 300 amperes at 600 volts, a switch as above described will open a short circuit without the slightest injury to contacts; and by the addition of a pair of simple spring brass brushes, so arranged as to shunt the main circuit on two carbon plates and to break the shunt circuit last, an "Ajax" switch can be made to successfully break an almost unlimited amount of current at a very high potential.

As an example, we may mention an "Ajax" switch which had repeatedly broken a circuit carrying 850

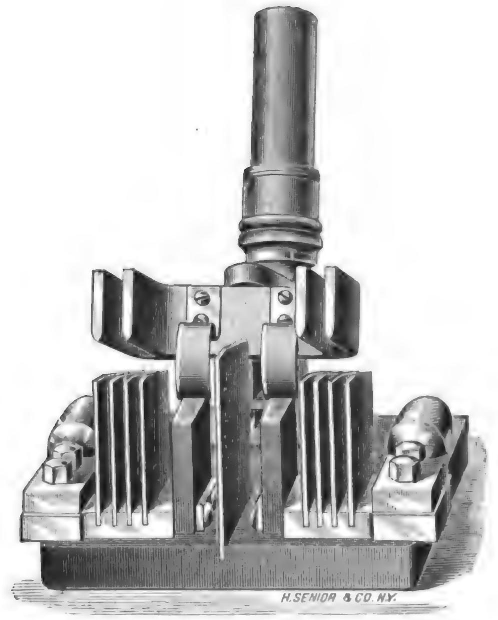


Fig. 2.—The "Ajax" Double Pole Switch.

amperes, close inspection of which failed to show that the switch had ever been used, so complete was the protection against burning or arcing.

The accompanying engraving, Fig. 2, shows the double blade for very heavy capacity switches, as well as the carbon plates of the shunt circuit, with the light brass springs still in contact after the main circuit is broken.

The illustration, Fig. 3, gives a good idea of the form of the "Ajax" feeder switch cut-out. This form of switch occupies a very limited space on the switch board, a valu-

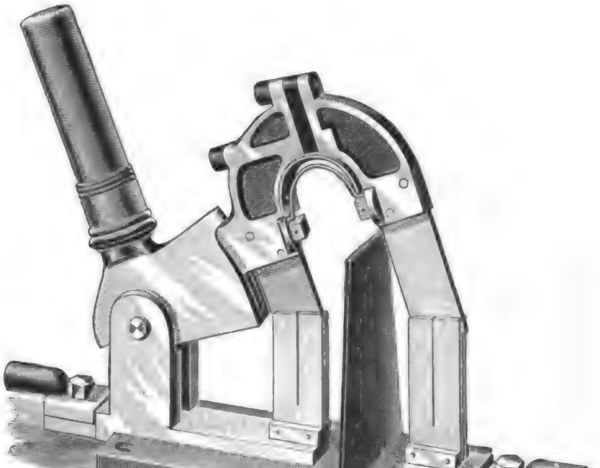


Fig. 3.—The "Ajax" Double Pole Switch.

able item where a short "bus rod" is required to supply current to many feeders, and, as shown, makes a very desirable form of feeder cut-out. A suitable insulation is inserted in the curved tongue, so as to electrically separate its ends; the under surface of the arch is lined with fibre, which projects well beyond the sides of the castings, so as to prevent the formation of an arc when the fuse melts;

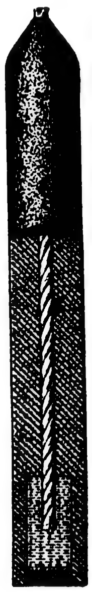
and large cap screws, with washers, secure the ends of the fuse wire which electrically connects the copper blades.

By this construction, it will be seen that, besides the small space occupied, one insulating screen answers for both cut-out and switch and that a fuse wire can be replaced while the switch is open, and consequently out of circuit, without the usual multiplicity of connections to accomplish the same result.

The "Ajax" switches are already well-known among street railway men using electricity as a motive power, and they are being sought by users of stationary motors and large incandescent lighting plants, who appreciate their qualities of indestructibility and simplicity of action.

SAUNDERSON'S IMPROVED ARC LIGHT CARBON.

For many years there have been efforts made for the improvement of carbons for electric arc lamps with some measure of success, also for introducing various materials into the arc, but in no case has any important advantage been gained. In many cases certain substances have been ground up and incorporated with the carbon, with the result that ashes or clinkers have been formed to such an extent as to render the light of less rather than greater intensity. The most successful carbons have been those



The Saunderson Arc Light Carbon.

made up with finely powdered soft carbon dust. A very remarkable discovery, says the London *Electrical Engineer*, has been made, which will certainly give an enormous impetus to electric lighting. The inventor, Mr. Llewellyn Saunderson, of Kingstown, County Dublin, whilst experimenting with the arc lamp in his endeavors to improve its powers to pierce fog, so as to minimize loss of life at sea, determined upon introducing into the arc minute quantities of intensely heated hydro-carbon vapor, so as to enrich the light with the well-known fog-piercing rays, viz., yellow and red. Having succeeded by this means in producing a beautiful sunshine yellow, he discovered that at the same time the intensity of the light was enormously increased. A plant was put down, consisting of gas-engine, dynamo, and electric arc lamps, and the innovation was followed up by introducing various gases in to the arc in a number of curious ways, only a few of which can now be described. The first consisted of a jet through which the vapor was projected into the arc, then two jets, and so with a number of other contrivances. The hydro-carbon was vaporized in the tube leading to the jet, and retarded in its passage by asbestos, etc., to give the carbon time to bring the vapor up to an intense heat, and a wick was employed to prevent the vapor from going back, as well as to supply fresh fluid by capillary action.

In a series of tests recently made by Dr. John Hopkinson, with the Saunderson carbon, two arc lamps were provided, identical in all respects, with the exception that one of them was provided with the new carbon which is illustrated in the accompanying engraving. The E.M.F. and current supplied to each arc were measured by voltmeters and ampere-meters, which were afterwards compared with each other, and were found to give the same indications for the same currents. The lights given by the two arcs were compared by a photometer, generally of the ordinary construction.

The final results arrived at by Dr. Hopkinson were as follows: Mean potential of ordinary lamp, 39.8 volts; of new lamp, 41.4 volts; mean current of ordinary lamp, 12.4 amperes; mean current of new lamps, 11.1 amperes; mean energy in ordinary lamp, 493.5 watts; mean energy of new lamp, 459.5 watts; mean ratio of the light given by the new lamp to the light given by the old lamp, 1.88. Thus, in these experiments, whilst consuming somewhat less energy, the new lamp gave nearly double as much light as the old lamp. Dr. Hopkinson concludes, therefore, that in an arc of this size a substantial advantage is gained from the use of the invention.

Among the other advantages claimed for this discovery we may mention increased steadiness, and, instead of the bluish tint always present in the ordinary arc, a fine rich, yellowish-white color, very agreeable to the eye, is produced, being almost exactly the same as sunlight, and having, it is said, an enormously increased power of penetrating fog, so important for lighthouse purposes, and for use in the military and naval electric light projectors.

The item of expense in applying the new system is said to be so small that it may be neglected altogether, and very little or no alteration of the present arc lamps is required. The simplicity and cheapness of manufacture is, in fact, so great that it is probable not more than 20 per cent. or 30 per cent. in total cost need be added to the present cost of the carbons against the diminution of the general cost.

It may well be asked how these results are attained. Up to this moment there is, perhaps, no sufficient explanation, but it is highly probable that the exceedingly fine particles introduced into the arc, and impinging against the upper carbon by the ascent of the hydro-carbon vapor, are acted upon with great advantage by the electrical energy, whereas the harder particles of the carbons have to be taken from their state of cohesion, greatly reduced in size, and even then only a small percentage are found suitable for the higher incandescence (from which most of the light is derived), the grosser particles falling in dust, found after the lamp has gone out; while portions more refractory are discharged at all angles, and sometimes with considerable force.

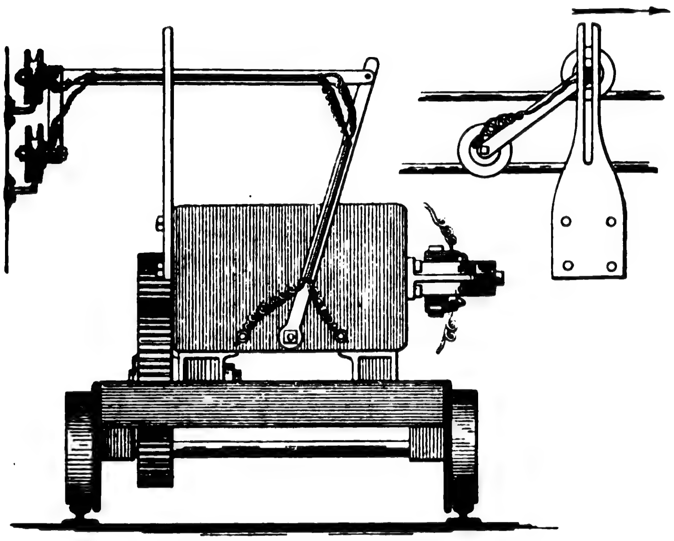
The quantity of vapor required is astonishingly small, that which can be produced from a drop of oil lasting, with ordinary carbons, nearly a minute. It is, however, not necessary to employ oil, but almost any substance or semi-liquid which on being heated gives off the vapor will answer well. For example, vaseline, enclosed in a small capsule of the same size as the rod of carbon, and not more than about ½ inch long, will hold sufficient for the burning of the carbon down to the usual length at which it is generally taken out and thrown away. It is probable that the minute quantity of vapor required is acted upon freely, and that in its turn the incandescent gas or particles of vapor assist largely in effecting the separation of the particles of the carbon electrodes, for the consumption of carbon is increased by about ¼th part.

This invention is now being-tried in a large installation in England. The results have been found to be practically the same as those certified by Dr. Hopkinson.

BAIN'S ELECTRIC COAL MINING MACHINERY.

AMONG those who have devoted considerable attention to applying the electric current in various ways to the operations carried on in coal mines is Mr. Foree Bain, of Chicago; indeed, he claims to be the pioneer of this work in this country, it being now about one year and a half ago that he installed a complete electric plant in the coal mines of the Shawnee and Iron Point Iron and Coal Company, at Shawnee, Ohio. This plant consists of a well-known coal cutting machine, which had been previously operated by compressed air, but is now driven by a Bain mining motor an electric locomotive capable of hauling a train with 25 tons of coal up a 5 per cent. grade, and a system of incandescent lamps from the same circuit, which are used to illuminate the rooms and entries of the mine.

The electric locomotive employed in the mine is capable



BAIN'S ELECTRIC MINING MACHINERY.

of hauling 1,000 tons per day; one boy who is paid $2 per day to run it and another who gets $1.25 per day to couple cars and attend to switches, is all it costs for wages, and they take the place of 15 drivers and 15 mules, and, according to Mr. Hull, the superintendent, "it is an unquestioned success."

Mr. Bain has recently worked out and patented a complete system of mining coal by electrically operated machinery, which consists of an undercutting machine and an overhead drill for drilling a hole in which to place the blast. This hole is drilled at the same time the undercut is made, and is operated simultaneously by the same motor.

The undercutting machine is made in two principal parts, viz., the outside frame to which the traction wheels are removably attached, and the inner frame which telescopes within the outer frame; the inner frame carries the motor and the drills. There are thirteen drill rods placed parallel and in front of the motor, and every alternate drill rod carries a special steel conveyer, stamped from sheet steel and firmly secured to the rod. The object of the conveyer is to remove the cuttings from the drills while the slot is being cut into the coal. The drills or cutting bits are removably attached to these drill rods at their extreme forward ends in such a manner that they overlap each other in their rotation to cut through intersecting planes. The drills are grooved together near their rear ends to rotate alternately in opposite directions; by this arrangement it will be evident that a continuous slot, penetrating in most cases six feet, can be cut with rotary cutters, without interference of the cutters with each other. Their relative direction of rotation is such that should any one cutter for any reason tend to lag in its work, it would be assisted by those on either side of it.

The motor, which is mounted on the inner frame, and which rotates the cutting bits, also supplies the power which gives the system a reciprocating motion to feed into the coal; a clutch immediately in front of the motor connects it with the driving and cutting mechanism, and another, located under, and at the rear of, the motor, is thrown in one direction to withdraw the system after the slot has been cut. The retrograde movement is arranged for a speed four times faster than the speed at which the bits are fed into the coal. After the cut has been made the machine is shifted and another cut parallel with the first is made in the same manner, and so on, until the room has been finished. When it is desired to remove the machine to another location or room, it may be slightly raised and traction wheels put into the studs; the cutting machine may then be disconnected by use of the front clutch lever, and the machine then becomes self propelling and can move itself around on the floor of the mine or on the tracks in the entries. For long distances it is supplied with the trolley device, illustrated in the accompanying engraving, and it may also be used as an electric locomotive for drawing a small number of cars.

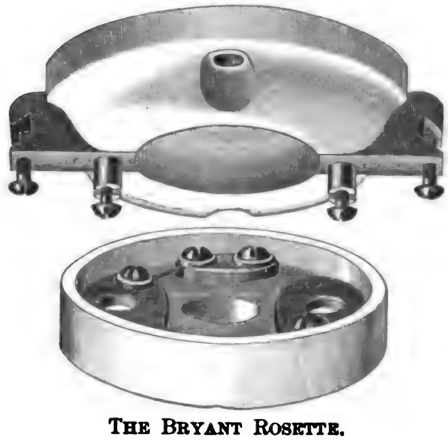
In good coal the machine will cut a slot three feet wide, four inches high, and six feet under within three minutes. It is operated by a specially constructed motor of only 6 h. p., which, like all of Mr. Bain's electric mining machinery, is operated at 225 volts.

THE BRYANT ROSETTE FOR FUSIBLE CUT-OUTS.

PRESENT practice in electric lighting requires that as far as possible each individual lamp shall be protected by a safety fuse, and this is specially required in pendant lamps suspended from rosettes attached to ceilings. These rosettes usually contain the fusible cut-outs, and when a burn-out occurs, the ordinary detachable cap is removed and a new fuse is inserted in the cap.

The attendant is thus enabled to avoid the inconvenience, as well as the danger, of accidentally completing the circuit while adjusting the fusible connections. In practice he removes the cap, places the fusible connections therein, then replaces the cap, and secures it in place. It is of course important that this connection should be made in the quickest and simplest manner possible, so as to avoid the formation of an arc while adjusting the cap in place.

In the rosette or ceiling block recently brought out by



THE BRYANT ROSETTE.

the Bryant Electric Co., of Bridgeport, Conn., a special arrangement has been adopted by means of which the attendant places the cap in position, so as to complete the circuit by a single movement, thus avoiding the formation of an arc. At the same time the construction is such that the positive and negative wires are connected at the same instant, and when the connection is once made it does not have to be broken in attaching the cap in place.

The manner in which this is accomplished is shown in the accompanying engraving, which illustrates the rosette, the cap being removed from the base. Both are made of porcelain. As will be seen, the base carries a pair of screw lugs, which are connected to the circuit wires. Cast on to

each lug is a short pillar carrying a screw, which is placed somewhat eccentrically in the pillar, and the object of which will be explained presently.

The cap carries a pair of brass plates to which the flexible cord is attached, and these plates are connected to a second pair of plates by means of the fuse wires. The latter pair, it will be noticed, are perforated and fit directly over the pillars on the connecting lugs in the base.

When the fuses have been inserted the cap is brought down on the base, the pillars passing through the perforated brass plates in the cap. By then merely screwing down on the screws in the pillars, the under sides of the eccentrically placed screw heads bear upon the brass plates, thus securing the cap firmly in place, and making electrical connection with the circuit wires at the same time. The construction is very simple and the block presents a neat appearance.

THE "CONVENTION" DOUBLE POLE INCANDESCENT SWITCH.

SIMPLICITY of construction, efficiency in operation, and cheapness are the three main points which are looked for in any good article. These three points are aimed at in the new "Convention" incandescent double pole switch, which we illustrate below, and which is manufactured by the Illinois Electrical Material Company, Chicago. The sectional view shows the contact bar resting on the insulated ratchets. To close the circuit it is only necessary to turn the handle to the right, and the bar will climb the

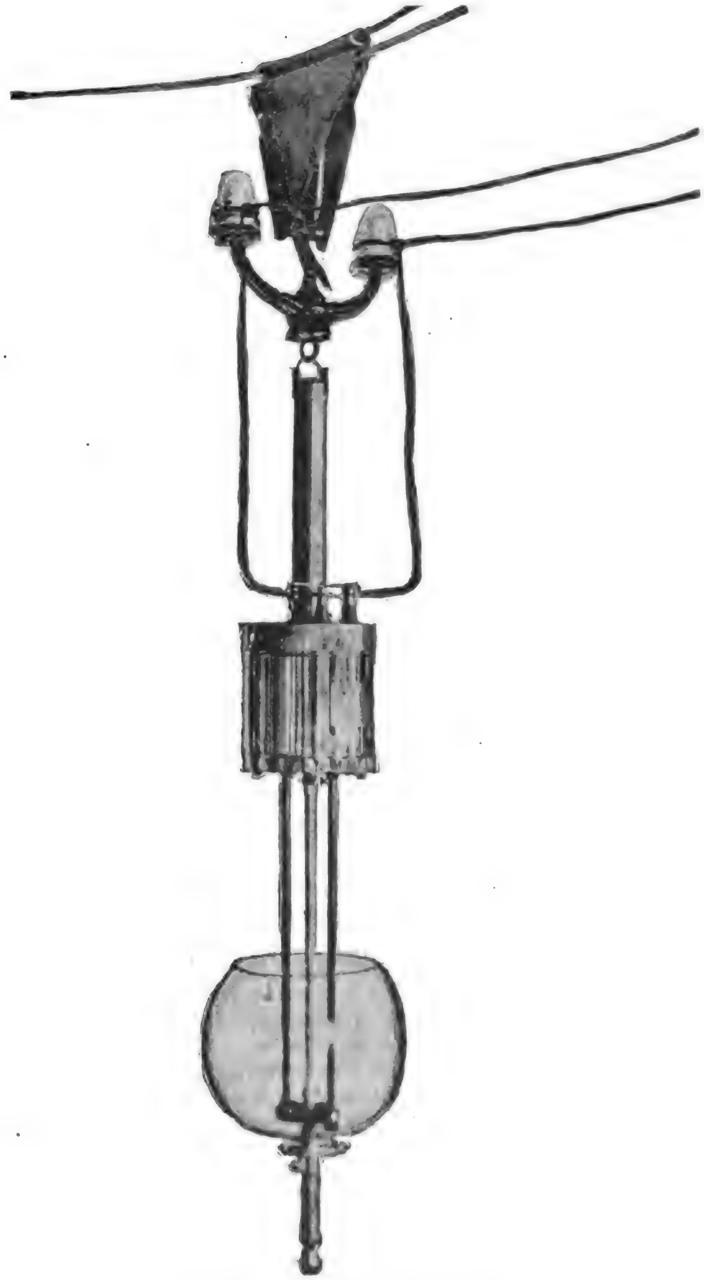
THE "CONVENTION" DOUBLE-POLE SWITCH.

grade and take a horizontal position on the brushes fixed on both sides, while a second turn gives an instantaneous brake, the bar being thrown off by the force of the spring about three-sixteenths of an inch. The ratchets are made of insulating material, as is also the block supporting the contact bars, the small slot cut sideways in the centre block aiding to throw the contact bar of the ratchet the necessary distance. To convert into a single pole switch, it is only necessary to remove the outer contact brush.

THE "FOREST" LAMP HANGER.

WHERE arc lamps are required to light outdoor or large interior space it is necessary to provide means for lowering them for cleaning and trimming, and in the past frequent trouble has arisen, and in some instances loss has been incurred, by the breaking or malicious cutting of the rope by which the lamp is suspended. To avoid this the Forest City Electric Works, of Cleveland, O., has recently brought out a novel lamp hanger which is illustrated in the accompanying engraving. As will be seen, the lamp is entirely supported by a hook on the line-wire supporting frame, which engages with a steel pin in the hood, thus taking all strain off the raising and lowering cord. This cord is not in use except when raising or lowering, and will, therefore, last much longer than when used to support the lamp. Cutting or untying this cord maliciously cannot drop the lamp, as, to disengage it from the hood, the lamp must be raised about six inches by the cord.

When used to support a lamp over a street, the sheet steel hood is supported by a cross wire or cable and held in position by as mall wire or cord running to the pole. This allows of placing a lamp readily at any point over the street,



THE "FOREST" LAMP HANGER.

and if it is desired to trim the lamp at one side of the street, as in the case of wires interfering, the position cord can be released and the raising and lowering cord will draw the entire hanger to one side of the street and release the lamp, which will then come straight down; and when trimmed it can again be pulled into engagement with the hood. The entire hanger with the lamp is then drawn along the cross wire to its proper position over the street.

By the construction adopted the lamp is also entirely insulated from the hanger and no strain whatever is brought on the lamp connections.

A NEW WALL BRACKET.

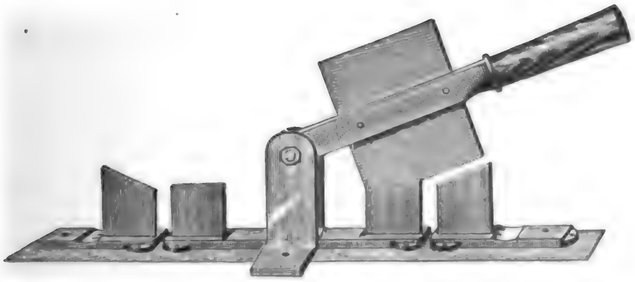
The same steady demand for higher insulation which has led to the production of good weather-proof wires, has also resulted in the bringing out of a finer quality of insulators and of better means of supporting them. The latest of these improved supporting devices is shown in the adjoining cut. It is called the "Springfield bracket," and is manufactured by the Great Western Electric Supply Co., of Chicago. Being made of malleable iron, with a ribbed arm and a hollow screw, it is very light, strong and tough. The split screw has a slight give to it and grips

A NEW WALL BRACKET.

the insulator tightly. The wall plate is also novel in design, being so shaped as to give a large spread with very little metal. The makers have, they report, in preparation other forms of malleable iron brackets embodying the same good features as the above.

ALTERNATING CURRENT SWITCH.

The accompanying illustration represents a new design in alternating current switches, just brought out by Messrs. J. Lang & Co., of Chicago, the manufacturers of the well-known "Andrews" switches. In the switch shown the contact is instantly made and broke across the entire face



ALTERNATING CURRENT SWITCH.

of the clips. The blade and tongue are made of the best hard rolled copper, and the brass used is of the highest conductivity. The switch is made in single or double pole styles.

NEW YORK SUBWAY LITIGATION.

The first skirmish in court in the $2,500,000 suit of the North American Underground and Electric Company against the Consolidated Telegraph and Electrical Subway Company has resulted in a defeat for the plaintiff company. The North American wants the Consolidated Company forced to use the Johnstone system of conduits and pay $2,500,000 damages for the failure to use the system. It also wanted an injunction pending the determination of the suit to restrain the Consolidated Company from laying or maintaining any other system of underground conduits than those of the Johnstone system. Judge Beach, of the New York Supreme Court, before whom the motion for the injunction was argued, handed down a decision on August 11 refusing to grant the injunction.

THE ASSOCIATION'S MEMORIAL TO CONGRESS ON THE ELECTRICAL CENSUS.

An important memorial has been presented to Congress in the name of the National Electric Light Association, favoring the authorization of a special census investigation, and report on electrical industry, and a special appropriation of $50,000 for that purpose. The memorial was presented by President Marsden J. Perry, through Senator Hale, and ordered to be printed. It is Misc. Doc. No. 197, Senate, 51st Congress, First Session.

This paper rehearses the familiar steps taken to secure the special census and appropriation by the Association and quotes the Census Act bearing on the subject. It points out that in the census of 1880 only three brief chapters are given to the telegraph and telephone, and it enumerates 41 leading subjects upon each one of which a special chapter should be written by experts. It then proceeds as follows:

"It is our duty to lay claim to all honors to which American inventors and artisans are clearly entitled for their genius of invention or skill of adaptation. This should be done by concise and circumstantial historical statements in the first official report ever published by any nation on the electrical industry. The proud pre-eminence of this country in these respects is most marked. There is not a nation in the world that is making use of the many practical applications of electricity without using the creations of American inventions or the products of American factories.

"How much reason there is for such claims and the broad field they cover will be readily understood when it is known that of the 205,479 patents issued by the United States Patent Office for the ten years ending December 31, 1889, 12,591 pertain to apparatus for some practical application of electricity. The profits of the Patent Office for those ten years have been $2,210,863.76, averaging nearly $10.76 per patent issued. Upon this basis, inventors working in the field of the electrical industry, have paid to the Government a profit of $135,473.62; therefore, in requesting that the Government shall authorize and provide for an exhaustive investigation of, and report upon, the electrical industry, they are only asking a fitting recognition from their beneficiary.

"It is believed that upwards of two hundred establishments are to-day engaged in the manufacture of electrical apparatus and supplies. The aggregate number of persons employed, the amount of material consumed, and the total capital engaged, are sufficient to rank this industry second to none other in importance. This is especially true when it is considered that about 80 per cent. of this industry has been brought into existence since 1880, and is engaged in the production of apparatus of a kind and for a purpose never before known in the history of the world. The single item of copper consumed annually by this industry is estimated at 50,000,000 pounds. The producers of copper are protected by a duty of 4 cents per pound. At this rate the tariff tax upon this industry for but one item amounts to $2,000,000 annually. In view of this it is clear that, from the stand-point of the manufacturers and their army of employés, the investigation sought and the appropriation therefor is not a request as for a favor to be done, but for the recognition of the Government's most liberal supporters.

"The magnitude and unquestioned importance of the services being rendered by electricity is made quickly apparent by the shortest possible mention of the principal features of its work. Since the tenth census the capacity of telegraph lines has been doubled and quadrupled by improvements in instruments. The wonderful feat of telegraphing to and from moving trains has been brought into practical use. The power of holding a conversation between persons in distant cities has been acquired. Electric nerves may now terminate in every office and residence, making communication with any centre of population in the world possible and easy. The outburst of every fire, the ambulance call for every accident, the secret information to the police of every crime, is intantly announced. All these features of improvements are fast rendering the conditions of urban life radically different from what they were a few years ago. New conditions are created, hitherto unknown to commercial and social life. To investigate and make an exhaustive, impartial, and truthful report regarding these improvements is a duty the Government owes to itself, for upon such information only can its action and that of the several States and the municipalities be intelligently based regarding questions of the first importance.

"In the department of mechanical illumination the gas industry, over fifty years old, can show but 1,043 central plants. There are to-day upwards of 1,500 electric central stations furnishing a light that was wholly unknown to commerce ten years ago.

"Street cars drawn by horses were first operated fifty-eight years ago. The system now includes about 5,902 miles of track, operating 18,000 cars, and carrying 3,600,000 passengers daily. The first electric road went into use only five years ago. There are now upwards of 1,753 miles of track, operating 3,000 cars, carrying 1,200,000 passengers daily.

"But three or four years ago the only method by which a working man could cause mechanical power to serve him in his efforts to maintain the independence of the self-employed was to

own a steam or water plant, the cost of which, together with its necessary attendant conditions, was prohibitory. He was thus condemned to spend his life as a wage-earner. To-day, at a monthly cost of about $10 per horse-power, clear of all collateral expense, he can obtain electric power delivered into his own home if he desires. For this small outlay, which every mechanic can easily make, there is placed at his command by the systems for the electrical transmission of power for stationary work physical power eight times that of his own strength, and he is able to use this vast and tireless power without effort for its production on his part. This not only largely increases his earning capacity, it opens the door to independent self-employment, the key to which is the ability to make mechanical power his servant.

"Going back less than five years, we find women thankful for the opportunity to tread out their lives at the machine, because thereby they found a means of honorable self-support. To-day, the tireless energy of electricity emancipates the woman from all physical effort to create power to operate her machine, at the same time increasing her earning capacity and enhancing enormously the ease and comfort with which her work may be done. This relief from the necessity of physical labor for men and women is accompanied by other conditions for the betterment of health and comfort that are moral and social factors of no less importance than the industrial and commercial. It allows the physical vitality formerly exhausted by the drudgery of treading out mechanical power to supply greater strength to the brain, nerves, and muscle, thus making a degree of intelligence—the soul of skill—easily attainable, that has heretofore been unknown. An interest such as this is worthy of the fullest recognition that can be given to it, not alone for its magnitude and the support the Government draws from it in a hundred ways, but for the sublime genius and enterprise that has induced, within one decade, an industrial and commercial development unknown to the centuries of the past."

The memorial then enumerates other lines of work of importance, and calls attention to the demand there is for data on electrical questions.

"The importance of these considerations can not be fully shown without calling attention to the urgent and wide-spread demand for the information indicated. The municipal council of every city, the legislature of every State, the National Congress itself, and governments of foreign countries, have all been persistently searching for it. This is conclusive evidence that it has never been collated and will be of the highest value when produced. Every city, every State, and the National Government is now spending money, in the aggregate an untold amount, in isolated efforts to obtain proper data upon which to base legislative action on questions of vital importance to the welfare of the people.

"Information obtained by the methods that have been followed must at best be incomplete and partial. The Census Office can in no way furnish a better demonstration of the incomparable value of its work than by obtaining and supplying the data as desired and indicated. The cost of doing this will not equal the cost of a single day's time of the legislative bodies throughout the country that require it for their use. Statements that electricity has caused the destruction of a certain amount of property by fire, has killed a certain number of people, or that the service rendered by it cost a certain amount of money, are absolutely valueless as guides to legislative action, unless they be made in comparison with the results of the use of other agents for the same purpose. The reasons given for making a special investigation of the electrical industry are reasons why the inquiry should be conducted with the greatest possible care, so that every point of comparison may be easily made, and all action based upon data officially published, may ultimate in sound economic and social results."

NEW ELECTRIC LIGHT AND POWER INSURANCE RULES.

WE publish below the new rules and regulations advised by the Boston Manufacturers' Mutual Fire Insurance Co. for the installation of electrical plants, and adopted not only by them, but by the Boston Fire Underwriters' Union and the Electrical Mutual Insurance Co. They were specially prepared by C. J. H. Woodbury, F. E. Cabot, C. M. Goddard and S. E. Barton. They are accompanied by a circular from President Edward Atkinson, in which he says:—"It may be stated that when electric lighting was first introduced, many years since, in mills or works insured by this company, mainly on the arc system, we had twenty-three cases of fire in sixty-one installations, but without any loss, within six months from the beginning. During that period the subject was thoroughly investigated and rules were prepared, by which all our members have been governed since that time; the rules now presented are a development rendered necessary by numerous inventions and improvements in the applications of electricity to illumination and to the transmission of power. There has not yet been a loss from any fire which could be attributed to electricity, generated for purposes of lighting or for motive power, in any mill or works insured by this company. The experience for ten years has sustained our position that a well installed electric lighting system is the safest method of illumination."

Dynamos and Switchboards.—1. Dynamos must be located in dry places, not exposed to flyings or combustible material, and must be insulated upon dry wood, filled to prevent absorption of moisture. They must be kept thoroughly clean and dry. They must be provided with a reliable, automatic regulating device, or a competent person must be in attendance near the machine whenever it is in operation. In wiring for motive power, the same precautions should be taken as with a current of the same volume and potential for lighting.

Each machine should be provided with a water-proof cover, which should be used whenever the machine is not in operation.

2. Switchboards, or other apparatus near the dynamos for controlling circuits and currents, should be so located that they will be accessible, and open on all sides, and entirely disconnected from all wood work or combustible material; also kept free from moisture. They should be incombustible, and rendered non-absorbent of water.

Motors.—3. They must be located in dry places, not exposed to flyings or combustible material, and must be insulated upon dry wood, filled to prevent absorption of moisture. They must be kept thoroughly clean and dry. They must be self-regulating, or a competent person must be in attendance near the machine whenever it is in operation. All resistance boxes or devices should be made of non-combustible material, or so located that they cannot communicate fire to any surrounding combustible material. In wiring for motive power, the same precautions should be taken as with a current of the same volume and potential for lighting. The motor (and resistance box) should be protected by a cut-out, and controlled by a switch.

4. Motor cars driven by electricity from a single wire with earth or floor return circuit will not be approved in any building insured by this Company. The use of such single trolley tracks may be permitted, after special inspection, in mill yards where there is no liability of other conductors coming in contact with the trolley wire, and where the conditions of the position of the generator is such that the ground circuit will not impose any fire hazard on the property.

5. Wires for electric lighting or stationary motors will not be permitted in the same circuit with trolley wires with ground return—the Stock Insurance Companies will permit such installations, subject to special inspection and agreement, on payment of a suitable charge for the permit covering this increased hazard —although the same dynamo can be used, if desired, for both purposes, provided that the connection from the dynamo to each of the two circuits shall be by a double-throw switch so that only one of the circuits shall be in service at the same time. In such cases the wires for lighting or stationary motors shall be in the usual manner, entirely on a metallic circuit without ground.

Testing.—6. All circuits should be tested at least twice a day with a suitable magneto, or other approved device, in order to discover any escapes to ground that may exist. One test should be made in the morning, and another in ample time before starting, to remove any defect, should it be found to exist. The rules for testing should be observed in any separate or isolated plant the same as in Central Stations.

ARC SYSTEM.

Outside Wires.—7. All outside overhead wires must be covered with some material of high insulating power, not easily abraded; they must be firmly secured to properly insulated and substantially built supports. All tie wires must have an insulation equal to that of the conducting wires.

8. All joints must be so made that a perfectly secure and unvarying connection, fully equal to the cross-section of the conducting wire, will be secured—and they should be soldered. All joints must be securely wrapped with an approved tape.

The following formula for soldering fluid is recommended:— Saturated solution of zinc, 5 parts; Alcohol, 4 parts; Glycerine, 1 part.

9. Care must be taken that conducting wires are not placed in such position that it would be easy for water, or any liquid, to form cross connection between them, and they should not approach each other nearer than one foot. The wires must never be allowed in contact with any substance other than air, and their proper insulating supports; except that service wires with special insulation may be permitted to touch foreign substances.

10. Conducting wires carried over or attached to buildings, *must* be at least seven feet above the highest point of flat roofs, and one foot above the ridge of pitched roofs. Lines constructed subsequent to the adoption of these regulations should not be run over and attached to buildings other than those in which the light or power is being, or is to be used, but should be on separate poles, or structures, where they can be easily reached for inspection.

11. When they are in proximity to other conducting wires, or any substance likely to divert any portion of the current, *dead, insulated* guard-irons must be placed so as to prevent any possibility of contact in case of accident to the wires or their supports. The same precautions must be taken where sharp angles occur in

the line wires, and also where any wires (telegraph, telephone, or others) could possibly, owing to their position, come in contact with the electric light wires.

12. Overhead wires from the main circuit or pole in the street to the terminal insulators attached to buildings, and at the point where they enter a building, must not be less than twelve inches apart. They must be rigidly and neatly run and supported by glass or porcelain insulators or rubber hooks.

13. Service blocks must be protected by at least two coats of water-proof paint over their entire surface; and, when used to support rubber hooks, must have at least one inch of wood between the inner end of the hook and the back of the block.

14. For entering buildings, wires with an extra heavy water-proof insulation must be used from the terminal insulators through the walls from the outside to the inside of the building. They must loop down, so that water may drip off, without entering the building, and the holes through which they enter should, where possible, slant upward.

15. Wires must enter and leave the building through an approved cut-out switch, which must be "double contact," and should effectually close the main circuit, and cut off the interior, when turned "off." It must be so constructed that there shall be no arc between the points when thrown "on" or "off." It should be automatic in its action in either direction, not stopping between points when once started. It should indicate upon inspection whether current be "on" or "off." It must be mounted on a non-conducting base, kept free from moisture, and easy of access to firemen and police.

Inside Wires.—16. Wires must not be concealed, and they must be rigidly kept apart at least one foot, unless an *approved, moisture-proof, non-conducting, non-inflammable tubing* is used. This tubing must be sufficiently strong to protect the wires from mechanical injury. It may be fastened to the wall by staples, provided the tubing is not broken or injured thereby. Wires in this class of tubing may be run as near as three inches to each other.

17. Conductors in buildings must be thoroughly well insulated with non-absorbent water-proof material, as incombustible as possible, which will adhere to the wire and not fray by friction, and will stand a temperature of 150 degrees without softening.

In places liable to dampness, wires must be thoroughly and carefully run on glass insulators, rubber hooks, or porcelain knobs of suitable size and shape, and the wires must be separated at least eighteen inches. They must also be provided with an approved water-proof insulation, or encased in an approved tubing.

When wires pass through walls, floors, partitions, timbers, etc., in-doors, glass tubing or so-called "floor insulators," or other moisture-proof, non-inflammable, insulating tubing must be used.

18. All lightning-arresters must be grounded outside of building, and preferably connected to a water-pipe.

Arc Lamps.—19. The frames and other exposed parts of arc lamps must be carefully insulated from the circuit.

Each lamp must be provided with a proper hand switch, and also with an automatic switch that will shunt the current around the carbons should they fail to feed properly.

Stops of some kind must be provided to prevent the carbons from falling out in case their clamps fail to hold them; and these stops must always be in place.

20. For inside use, the light must be surrounded by a globe resting in a tight stand, so that no particles of melted copper or heated carbon can escape. When any inflammable material is near or under the lamp, the globe must be protected by a wire netting. Unless a very high globe, which closes in, as far as possible, at the top, is used, it must be provided with some protector or spark arrester, reaching to a safe distance above the light. Broken or cracked globes must be replaced by perfect ones immediately. (By inflammable material is meant dry goods, clothing, millinery, and the like in stores; flyings or goods in fabric factories; shavings and sawdust in wood-working shops, or any other substance that can be readily ignited by droppings or flyings from the lamp.)

INCANDESCENT SYSTEM.

Incandescent Lamps on High-tension Circuits.—21. The rules for running wires for arc lamps apply also to incandescent lamps on circuits having a potential of over 350 volts. Incandescent lamps in single series on high-tension circuits must be provided with a suitable hand-switch, and also with an automatic device capable of shunting the circuit across the terminals of the lamp should the carbon filament break. When incandescent lamps are in multiple series, the hand switches must not control less than a single group of lamps, each of which may be provided with an automatic shunt, as above. Electro-magnetic devices will not be accepted as suitable for this purpose. Any method of distributing current to incandescent lamps on high-tension circuits, other than as above provided for, must receive approval before being put to use.

Outside Wires.—22. The rules 7 to 15 for outside arc wires also apply to outside incandescent wires, except that a cut-out switch in the circuit entering the building will not be required, but the wires from main circuit to main cut-out, inside of building, must be separated by a distance of not less than six inches, for currents having an electromotive force of 350 volts or less, and this distance must be increased for currents of high potential. They must also be rigidly and neatly run, and must be supported by glass or porcelain insulators, or by rubber hooks.

Underground Services.—23. Where underground service conductors enter a building, special care is necessary that they shall not come in contact with each other, or be placed where there is any risk of disturbance by moisture or mechanical injury.

There shall not be any free opening from underground wire conduits to buildings.

The service must not end in any place where it would be unsafe or undesirable to place a cut-out, but should be continued by means of specially insulated conductors (and a space of ten inches should be maintained between them) to a suitable location.

Inside Wiring.—24. For inside work, no wire smaller than No. 16 "B. & S.," or No. 18 "B. W. G.," will be approved. Before using any new form of insulation, the approval for its use under the proposed circumstances must be secured. The use of lead-covered wire, or wire the covering of which contains paraffine, is prohibited.

25. Mouldings with open grooves laid against the walls or ceilings will not be approved. A wood moulding with dividing strips between the grooves, at least half an inch in thickness, and having a backing of at least one-fourth inch thickness to intervene between the wire and the wall or ceiling of the building, the backing to be protected by at least two coats of water-proof paint and the moulding of such shape as to protect the wire from moisture, will be approved. Mouldings must not be used in wet places.

26. Wires laid in plaster, cement or other similar finish, or run over surfaces furred off for plastering, will not be approved, no matter what insulating covering is used. An approved moisture-proof, non-inflammable, insulating tubing or conduit may be used in such places. This tubing must be of sufficient size and so placed that the wires may be withdrawn and replaced at will. All joints and bends in this tubing must be made with suitable devices adapted especially for the purpose. Where this is done in such a way that the joints are moisture-proof, a double-braided cotton insulation, rendered non-inflammable, may be used.

A separate tube must be laid for each wire, except in the case of "taps" for not more than fifteen amperes, in which case conductors having insulation of cotton or other material which will readily carbonize, will be required. If a moisture-proof covering is desired, it must be placed outside the two conductors, and not between them. In other concealed places, such as unfinished lofts, between floor and ceiling, in partitions, etc., all wires must be covered with approved moisture-proof insulation, and fastened at distances not exceeding ten feet, so as to preserve at least two and one-half inches between the wires or any other electrical conductor. In lieu of such construction an approved moisture-proof, non-inflammable, insulating tubing or conduit with approved moisture-proof joints may be used, and the same rule as to insulation will be applied as in the case where the tubing is buried in plaster or similar material. Tubing passing through walls or ceilings must extend at least one inch beyond the finished surface, until the mortar or other similar material is entirely dry, when the projection may be reduced to one-half inch.

Tubes of such approved make may be laid side by side when imbedded in plaster or otherwise. At all outlets to and from cut-outs, switches, fixtures, etc., wires must be separated from gas-pipes or parts of the building by porcelain, glass or other non-inflammable insulating tubing, and should be left in such a way as not to be disturbed by plasterers. Wires of whatever insulation must not in any case be taped or otherwise fastened to gas-piping. If no gas-pipes are installed at the outlets, an approved substantial support must be provided for the fixtures.

Wires of the same polarity, but belonging to the different circuits, or leading to and from a double-pole switch, must not run in one groove, through the same tube, nor in the same slot in a cleat.

27. In dye houses, paper and pulp mills, and other buildings specially liable to moisture, all wires (except those used for pendants) must be separated at least six inches. The wire must be thoroughly and carefully put up, and must be supported by glass or porcelain insulators, or by rubber hooks. An approved, moisture-proof, non-inflammable, insulating tubing will be accepted in lieu of such construction.

28. In crossing any metal pipes, or any other conductor, wires must be separated from the same by a block of wood or other non-conductor of at least one-half inch, and so arranged that they cannot come in contact with each other by accident. Wires should go *over* water-pipes where possible. When wires pass through walls, floors, partitions, timbers, etc., in-doors, glass tubing, or so-called "floor insulators," or other moisture-proof, non-inflammable, insulating tubing must be used. Wires must never be left exposed to mechanical injury, or to disturbance of any kind. Wires of the same polarity, but belonging to different circuits, or leading to and from a double-pole switch, must not run in one groove, through the same tube, nor in the same slot in a cleat. Cleats should be made of well-seasoned hard wood (filled

to prevent the absorption of moisture), porcelain, or other approved material, and so made as to separate the wire at least one-fourth inch from the building. When secured by cleats not over four feet apart and tightly stretched, wires having a difference of potential of 120 volts or less, and carrying not over ten amperes, should be separated at least one and one-half inches; when they are confined in molding, a half-inch space is sufficient. Mains carrying currents of larger volume should be separated a greater distance.

The use of metal staples for securing wire will not be approved.

29. Where exposed to corrosive fumes, wires should be provided with an insulation that will not be injured thereby; and should be put up in the manner described in Rule 27.

30. All splices in wires must be soldered in accordance with Rule 8. A soldering bolt should be used for this purpose, if possible. Care must be taken not to render the wire brittle by overheating. The insulation of any joint must be equal to that of other parts of the same wire.

Safety Cut-Outs and Switches.—31. Every portion of each installation must be equipped with double-pole, safety cut-outs, that will interrupt the passage of a current in excess of the amount which any portion of the apparatus is adequate to transmit. A cut-out must be placed where the underground or overhead service joins the inside wires, and at every point where a change is made in the size of the wire (unless the cut-out in the larger wire is intended to protect the smaller). The plug or other device for enclosing or supporting the fusible strip or wire should be incombustible and moisture-proof, and so constructed that an arc cannot be maintained across its terminals by the fusing of the metal. No lead or composition strips carrying more than ten amperes before melting shall be used, unless provided with contact surfaces of some harder metal having perfect electrical connection with the fusible part of the strip. On any combination fixture, no group of lamps requiring a current of seven amperes or over shall be ultimately dependent on one cut-out. But there shall be a cut-out to each pendant and fixture.

32. Switchboards and cut-outs should be made of incombustible material, and arranged so that there will not be any leakage of electricity across them. They should be put in places not liable to contact with foreign substances, nor exposed to moisture.

33. All switches except those in lamp sockets should be double-pole.

They must have a firm and secure contact that will make and break readily, and that will not stick between "full on" and "off," nor get out of repair easily in other ways. The points of contact must not be allowed to scrape, or rub, the entire surface of an insulating material between the contact strips; an air space must intervene. The carrying capacity of the different parts must be sufficient to prevent heating.

Fixture Work.—34. In all cases where wires are concealed within or attached to fixtures, the latter must be insulated from the gas-pipe by some approved device.

When holes are drilled in fixtures, all burs or fins must be removed from the edge of the holes before the conductors are drawn through.

When wired outside, the conductors used must be so secured as not to be cut or abraded by the pressure of the fastenings or motion of the fixture.

All wire used for fixture work must have an insulation that is durable, and not easily abraded; and must not, in any case, be smaller than No. 19 "B. & S.," or No. 20 "B. W. G."

Each fixture must be tested for possible "contact" between wire and fixture, and for "short circuit" before current is turned on.

The tendency to condensation within the pipes or fixtures should be guarded against by sealing the upper end.

No combination fixture with less than one-fourth inch clear space between the inside pipe and the outside casing will be approved.

Pendants and Sockets.—35. Cord pendants must be composed of stranded wire, and protected by rubber bushings, or something equally good, where they enter the socket.

When exposed to weather, or used in wet rooms, care must be taken to keep moisture from the inside of sockets.

The weight of every socket and lamp suspended by a cord must be borne by a ceiling block, rosette, or cleat, and by a knot under the bushing in the socket, in order to take all strain from the joints and binding-screws.

Flexible cord must not be used except for pendants, wiring of fixtures, and portable lamps.

Secondary Generators or Converters.—36. Converters must not be placed inside of any building except central stations, and should be enclosed in a metallic or non-combustible case. They may be placed on the outer walls when in plain sight and easy of access, but must be thoroughly insulated from them. If placed on wooden walls, or the wood-work of stone or brick buildings, the insulation must be fire-proof. When an underground service is used, the converter may be put in any convenient place that is dry and does not open into the interior of the building; this location must have the approval of the inspector before the current is turned on.

37. If for any reason it becomes necessary that the primary wires leading to and from the converter should enter a building, they must be kept apart a distance of not less than twelve inches, and the same distance from all other conducting bodies.

38. Safety fuses must be placed at the junction of all feeders and mains, and at the junction of mains and branches when necessary; also in both the primary and secondary wires of the converter, in such manner as not to be affected by the heating of the coils. Secondary wires, after leaving the converter, will be subject to rules already given for inside wiring for incandescent lighting.

The secondary circuit may be provided with a film cut-out, which connects to the earth outside of the building; but permanently grounding the secondary circuit is unsafe and will not be sanctioned.

**Foreign Wires.*—39. No foreign wires of any kind shall be attached to buildings insured by this Company, for the purpose of carrying electric currents across the yard to any point.

40. All electric wires which may be required by the insured shall enter the premises at one point, preferably near the headquarters of the night watchman, where they can be kept under supervision; each of said wires shall be guarded by a protector against strong currents, operating by opening the circuit, and by a lightning-arrester.

41. Such protectors against strong currents shall be located in a dry, accessible place inside the building, and as near the point of entrance of wires as possible, and shall be without ground connection; such protectors shall be mounted on non-combustible and insulated supports, which shall be provided with a receptacle for the burning or melted parts of such apparatus.

42. The lightning-arresters on all wires must be placed between the protector against strong currents and the electrical portion of the apparatus within the building to which such wires are connected. No ground wires for such lightning-arrester shall be attached to gas-pipes within the premises of the insured.

43. All electric wires which may enter the premises of the insured must be insulated between the line wire on the insulator attached to the buildings outside and the protecting device within, with the best quality of water-proof insulation. Moreover, such wires must enter at a distance of not less than three inches from any other wire or any conducting material.

44. If any wires carrying high tension or strong currents are to be carried over or under other wires on the property of the insured, they shall be attached to poles so near to each other, with one wire so far above the other, that if a break should occur, the pendent wire between these poles may not be long enough to come in contact with the wire below, or, if not carried on poles, these wires shall be so placed or protected with guard-wires as to render a contact between different wires impossible.

45. If the high and low tension systems are in use in the same yard, even when developed within the works, the wires must be kept separate, and so wide apart that no contact or cross arc can be made.

Notice.—46. The Underwriters reserve the right at any time to add to, change, or modify these Rules, and to enforce such modifications, changes, etc., as shall be deemed necessary for safety; all reasonable efforts will be made to notify promptly all Electric Light Companies of any change.

THE DISCHARGE OF ELECTRICITY THROUGH GASES.

In a recent note appearing in *Nature*, Prof. J. J. Thomson writes as follows: "In the Bakerian lecture on 'The Discharge of Electricity through Gases,' in the last number of the Proceedings of the Royal Society, Prof. Schuster says: 'I do not see how the insulating power of air at the ordinary temperature is consistent with the presence of ions, however few in number, for ultimately a diffusion to the electrodes and a discharge would necessarily take place. This seems to me to be fatal to J. J. Thomson's views of the disruptive discharge.'

"This statement implies a misconception of the theory of the electric discharge advanced by me in the *Philosophical Magazine*, June, 1883, for there is nothing in the theory of the discharge there given which makes the presence of free ions in air at ordinary temperatures and pressures essential. I will quote two sentences from the paper to show what the theory is: 'In order to make the spark pass through an elementary gas, we have to decompose the molecules into atoms. Thus the stronger the connection between the atoms in the molecules, the greater the electric strength.' 'Chemical decomposition is not to be considered merely as an accidental attendant on the electrical discharge, but as an essential feature of the discharge, without which it could not occur.'

"The misconception has, no doubt, arisen from my using in the same paper the Clausius-Williamson hypothesis of the interchange of atoms among the molecules to account for the difference of pressure in different directions in the electric field. But

*The position of the Stock Insurance Companies is merely advisory upon this clause.

this hypothesis is not essential to the theory of the *discharge* given in the paper, for on that theory the discharge does not take place until *ordinary* dissociation of the molecules is produced by the electric field. The existence or non-existence of the quasi-dissociation of the Clausius Williamson hypothesis which does not produce any chemical effects, does not affect the theory of the discharge, though it does that of the inequality of pressure.'

THE CAPE MAY CONVENTION.

Promise of a Very Successful Meeting.—The Special New York Train.

August 17th, 1890.

Should this letter meet the eye of any electric light delegate who may be undecided whether to attend the Convention or not, I trust that what I may be able to write in the few minutes at my disposal may turn the scale in favor of a visit to this, the queen of watering places. Let him cast his eye over the list of the names of those who came down on the special train, and let me assure him that there are as many more good fellows who came at other times, and I feel confident that we shall have many more names to swell the list:

M. J. Perry and wife.
G. T. Manson "
A. M. Young "
W. L. Candee "
C. H. Barney "
C. O. Baker "
G. E. Barton, wife and daughter.
W. De L. Boughton, wife and child.
W. A. Anderson.
T. McCoubray.
Miss Moran.
H. L. Shippy.
T. A. Perrine.
J. P. McQuaide and wife.
J. A. Seeley.
M. J. Francisco, wife and daughter.
J. W. Godfrey.
H. D. Stanley.
C. W. Price.
O. E. Madden.
A. C. Shaw.
E. F. Peck.
Wm. Brophy.
George McKinlock.
J. A. Wetmore.
A. G. Carner.
Fred. Werner.
C. B. Faben, Jr., and wife.
E. R. Weeks and wife.
G. L. Austin and wife.
C. A. Bragg.
F. W. Royce.
W. D. Morris.
C. I. Hague.
J. B. Taltavall.
E. H. Stevens.

The special train left Jersey City about 2:05 Saturday afternoon under the careful management of our tried friend, Mr. H. M. Haines, who has so frequently guided the convention delegates on similar expeditions. The time was passed in the usual happy way known only to electrical men, and the presence of so many ladies added much to the enjoyment. Cape May was reached about 7:30, and after a hearty supper set forth by mine host, Mr. Theo. Walton, the delegates wandered forth to court the cool sea breezes, and talk over the experiences of past conventions and the prospective pleasures of the one just commencing. Besides the list of those I have given, there are already many more present from all parts of the country, too numerous to relate at present, but I notice more especially Mr. P. H. Alexander and wife, J. M. Orford and wife, D. A. Newton, M. E. Baird, C. L. Tolles, W. J. Jenks, W. C. Bryant, F. B. Platt, A. J. DeCamp and wife, J. R. Lovejoy, and a host of others. To-day the weather is simply perfect, a glorious blue sky overhead, a bright sun tempered by a cool ocean breeze, and a splendid invigorating surf, which thunders ceaselessly upon the white stretch of beach. Many of our friends indulged in a surf bath this noon, and seemed to enjoy to the full struggling in the mighty element, and pounding each other with sand, filling their lungs at the same time with the pure ozone from the Atlantic. Besides, ye tardy delegates, I will let you into a little secret. There is a lovely "convention" of most charming ladies at the Hotel Stockton at present, and from personal experience of my numerous electrical friends, I know that they form a great attraction. It will undoubtedly interest you to visit this entrancing spot, and see for yourselves all the good things provided for your enjoyment. Come and be enlightened, educated, entertained and "ozoned," and you won't regret it.

A. C. SHAW.

PUTTING FIRE ALARM WIRES UNDER GROUND.

The New York Fire Commissioners have sent to the Mayor and to the Board of Electrical Control a reply to the recent letter charging that the wires of the fire alarm service were not being put under ground as rapidly as might be. Superintendent Smith, of the fire alarm service, makes the counter charge that fire alarm wires are interfered with by employés of the Board of Electrical Control without authority, and often to the serious crippling of the service. Superintendent Smith reiterates that his department has been and is doing all that lies in its power to do in the way of putting its wires under ground and in ridding the thoroughfares of the city of its lines.

JERSEY'S NEW TELEGRAPH LINE.

The recently organized New Jersey Postal Telegraph Company is already at work building lines through Newark, the Oranges, Montclair, Plainfield, Rahway, New-Brunswick, and other places to Long Branch and other resorts further down the coast. The company is a branch of the Postal Telegraph Company and the Mackay Cable Company, and promises to give permanent first-class service. Its offices will all be open day and night, and messages will be promptly delivered by uniformed messenger boys on bicycles. The messenger and fire alarm service in Plainfield, where the company has purchased, as in other places, all rights possessed by smaller concerns, has already been revolutionized. The company promises special attention to newspaper dispatches.

CENTRAL STATION STATISTICS OF THE UNITED STATES.

THERE are nominally about 1,500 central stations in operation in this country. A compilation recently made by *Electrical Industries*, of Chicago, brings out the following figures, which are approximately correct, and do not err by overstatement:—

State.	No. of Central Stations.	Capital.	No. of Arc Lights.	No. of Incandescent Lights—16 C. P.	Engine Capacity, H. P.
Alabama	20	$ 4,381,500	2,265	11,510	3,495
Arizona	1	100,000	85	600	60
Arkansas	14	1,005,000	510	12,080	1,900
California	47	11,815,000	7,129	24,540	9,015
Colorado	26	8,000,000	3,029	50,155	8,560
Connecticut	26	3,857,000	3,430	37,477	5,200
Delaware	3	240,000	120	8,100	900
District of Columbia	1	700,000	400	7,000	1,100
Florida	6	245,000	485	3,100	750
Georgia	16	975,000	1,044	7,526	2,305
Idaho	3	70,000	......	2,100	210
Illinois	99	4,890,000	5,942	86,220	20,790
Indiana	57	2,616,000	4,132	15,138	7,805
Indian Territory	2	100,000	85	550	100
Iowa	48	1,750,000	2,179	36,477	6,745
Kansas	62	3,155,000	2,720	38,079	7,270
Kentucky	16	858,000	987	13,050	2,600
Louisiana	7	975,000	1,905	18,400	2,235
Maine	34	1,403,000	2,230	19,158	6,040
Maryland	14	1,735,000	855	20,375	4,660
Massachusetts	85	7,205,000	12,884	132,910	26,000
Michigan	68	3,410,000	6,802	33,332	13,625
Minnesota	28	2,275,000	1,781	37,140	6.830
Mississippi	7	219,000	605	2,650	790
Missouri	34	3,333,000	6,054	56,565	11,135
Montana	9	592,000	825	8,500	1,470
Nebraska	27	1,663,000	916	19,800	4,420
Nevada	2	125,000	190	600	320
New Hampshire	15	880,000	1,764	6,240	4,875
New Jersey	41	2,792,000	4,663	58,580	7,155
New Mexico	1	100,000	52	....	75
New York	135	23,247,000	23,361	259,649	88,785
North Carolina	16	525,000	818	4,283	1,160
North Dakota	6	400,000	289	4,475	825
Ohio	89	5,245,000	10,694	75,696	19,535
Oregon	13	1,210,000	356	11,215	1,375
Pennsylvania	111	11,706,000	12,672	266,052	42,780
Rhode Island	11	965,000	2,009	18,890	2,950
South Carolina	5	125,000	384	1,500	625
South Dakota	10	435,000	362	31,690	1,250
Tennessee	16	747,000	1,667	14,285	2,860
Texas	34	1,420,000	2,329	34,440	7,475
Utah	4	136,000	358	6,830	710
Vermont	12	955,000	865	6,350	1,960
Virginia	17	788,000	1,588	16,435	2,440
Washington	17	890,000	250	14.860	3,585
West Virginia	12	445,000	375	11,050	1,440
Wisconsin	48	2,830,000	2,946	39,120	8,380
Wyoming	4	230,000	100	6,200	685
Totals	1,379	$115,758,500	137,441	1,590,967	356,755

VARNISHING THE INTERIOR OF BEER CASKS.

The many accidents which have been caused by the ignition of the alcoholic vapors discharged during the operation of varnishing the interior of beer casks, which arise from the exposure of the illuminant required, can now be prevented. The ordinary lanterns used are now being replaced by the electric light. An incandescent light of small candle power is surrounded by a strong iron frame, which protects the lamp without obstructing the light.

LITERATURE.

Electric Light Fitting: A Hand-book for Working Electrical Engineers. By John W. Urquhart. New York: *D. Van Nostrand Co.* London: $2. *Crosby, Lockwood & Son,* 1890. 226 pp. 5x7½ in. Price, $2.

The number of electric light and power installations has grown so fast that those frequently placed in care of them are perforce taken from the ranks of the ordinary mechanic, and the "engineer" of an establishment is not infrequently put in charge of the electric plant. These men have usually had no practical training whatever in electrical work, and hence any handy book which can convey to them a working knowledge of the apparatus under their charge will add much to their usefulness. On the other hand, many young students about to enter into practical work of this kind would find their toil considerably lightened by a previous knowledge of the precautions necessary to observe in a successful plant, whether a central station or isolated. It is for this class that the author has put together a considerable amount of information which must be characterized as eminently practical and useful.

The first chapter of the work takes up the subject in its general aspects, and, after giving a brief explanation of the various types of machine, series, shunt, etc., and their regulation, brings the reader at once to the practical points to be observed from the time the dynamo reaches the station from the manufacturer until it is set in full running order. Besides important hints on erecting, and connecting up to engine or countershaft, the treatment of the brushes and commutator are gone into at length. We note among the precautions to be taken, where dynamos are transported in parts, a point not generally considered, though of vital importance. Thus it is pointed out that great care should be taken to remove all rust, dirt or oil from the joints between the magnetic surfaces, before bolting the parts together. It is probable that many of the difficulties experienced in starting newly erected dynamos are due to neglect of this simple precaution.

In chapter II. the author continues this part of the subject and enters at considerable length into the localizing of dynamo faults and the tests to be applied for leakage, broken conductors, burned out coils and the various ills to which a dynamo is subject. He points out the necessity for thorough insulation of the dynamo from the ground, neglect of which is the most prolific source of trouble, and usually the precursor of most of the others encountered. The author also treats of the repairs to the armature which may be necessary from time to time, and instances an interesting case involving the restoration of a dynamo to working order, after it had been deluged with water. This was accomplished by covering the dynamos with tarpaulins and applying steam at high pressure beneath them. After several hours of this treatment it is said that the machines were hot and dry enough to very shortly restore the insulation and did not suffer in any way by their bath. It would be well to remark, however, that though a rapid remedy for the restoration of wet dynamos is here pointed out, the cooling of hot journal bearings on a dynamo ought never be attempted by the use of water. The chapter concludes with a description of the methods of installing and operating accumulators.

The switch-board and testing work are treated of very fully in Chapter III., in which the various regulating and indicating devices are gone into at quite some length, and in which the illustrations employed aid the reader very much in obtaining a clear understanding of the text. Besides the various arrangements for running series and shunt machines in parallel, the author also describes a very simple method for throwing in alternating current dynamos in parallel at the proper time and the precautions to be observed in this operation. Here are also described the various tests for insulation, etc., the use of the Wheatstone bridge and the tests required during wiring in order to insure insulation when the work is finished. We notice on page 61 what is probably more an infelicitous expression than an error on the part of the author, who remarks that in discharging accumulators "they should never be allowed to fall below .5 volt." The omission of the word "below" would remove all ambiguity. Arc light wiring and fitting are next taken up by the author, and various types of arc lamps are described, as well as the method of their operation in series, or with incandescent lamps in parallel. Very full information is also given on the methods of running the wires, the insulation and placing of transformers, etc. House installation, including the house main, switch-board, meter and various other important details in this work, are thoroughly discussed. In the planning of a system of mains and feeders the author cites a very interesting method employed by the German Edison Company. The latter employ a large frame or table and make a clear plan thereon of the streets, buildings, etc., to be covered by the system. The location of the central station is then marked, and two wires from a small battery run to it to represent the electric supply. From this point the main leads are all laid down in miniature along the plan of the streets, and each group of lamps is represented by a wire resistance. The current is kept upon the system, and the drop of potential at each point carefully noted by galvanometer. Feeders are then run to equalize the potential, and by means of careful measurement every detail of the system can thus be ascertained. This model network is kept at hand, and as any alterations are required in the real network, they are first made upon the model. This plan has evidently many advantages over the paper and ink system of planning, and it seems worthy of note.

The author also enters very extensively into the description of electric light fittings and their wiring. In speaking of chandelier work, he remarks that a chandelier may generally be made to serve as a return within itself only. This practice, if permitted in England, is discountenanced in this country, where most of the underwriters' rules expressly forbid the employment of the chandelier as a conductor in any manner whatever. We think this rule perfectly justified, and the connection of any side of the circuit with the ground as a decided menace to the safety of the system. The work concludes with a chapter of the incandescent lighting of ships and a variety of miscellaneous information of value to electrical constructors.

The book is very well illustrated and printed, and has so many merits that it would be invidious to call attention to the slight inaccuracies which occur. The work ought to be in the hands of everyone in charge of an electric light plant, and though based largely on English practice, is to that extent all the more valuable as embodying information not generally accessible in this country.

"PROVING" OHM'S LAW.

In a communication addressed to the London *Electrician*, Dr O. J. Lodge writes as follows:

In one of the circulars issued to the Electrolysis Committee of the British Association, viz., that dated June 24, 1886, Prof. Fitzgerald suggested an objection to the complete validity of the theory of the experimental method of verifying Ohm's law with twelve-figure accuracy, devised by Clerk Maxwell, and carried out by Mr. Chrystal; doing so in the following words:—

"There is an objection to this method that I have not seen noticed. Maxwell assumes that you can expand in powers of $\frac{C^2}{S^2}$. Now, if the law were the positive value of $\left(\frac{C}{S}\right)^n$, where n differs very slightly from unity, the method would fail, for the current would vanish both in the numerator and in the denominator of Maxwell's expansion."

Maxwell's Theory is given in the Glasgow volume of the British Association for 1876.

In reply to this communication Prof. Sylvanus P. Thompson says:

The question which is raised by the communication which Prof. Lodge is circulating in consequence of the memoranda of Profs. Fitzgerald and Chrystal seems to need some care in handling, if it is not to increase the obscurity of the subject. If resistance is defined as the ratio of the electromotive force to the current which it produces, then the proposition that the electromotive force, divided by the resistance, gives (numerically) the current, is one which no more admits of discussion, nor needs experimental verification, than do the most elementary propositions of algebra. The experiments suggested by Maxwell, and tried by Prof. Chrystal, and those carried out by Prof. Fitzgerald, important though they are, cannot possibly be wanted to verify or prove Ohm's law. What they do go to verify or prove is, not whether the mathematical relation that bears the name of Ohm is true, but whether that property of an electric conductor which is called its "resistance" is, or is not, a constant. Now, it is common knowledge that the resistance is the function of at least one variable—the temperature; and it is quite a legitimate topic for inquiry, as Maxwell suggested, whether it is, or is not, also a function of another variable, namely, the density of the current passing through it. But why draw the line at these two variables? May it not equally be a function of such variables as the magnetic field in which the conductor is placed, the intensity of the illumination of its surface, the intensity of sound falling upon it, the intensity of the circumambient medium, the slope of temperature between its various parts, and the like? If it were found that the resistance of a conductor varied with any of these, surely one would not say that Ohm's law was false. One would simply say that the resistance was variable, and that if in Ohm's law one wrote the true value of the resistance corresponding to the circumstances, Ohm's law must then truly express the facts.

Now, whether this is granted or not, I invite the attention of the disputants in this matter to the very simple fact that for certain conductors, notably for iron and for bismuth, the resistance which they offer to currents of small density is assuredly not the same as the resistance which they offer to currents of large density, even if the temperature is artificially maintained equal in the two cases. It is known that these two metals—amongst others—when placed in a magnetic field, change their resistance. The fact was first discovered by myself and Mr. C. C. Starling in the case of the metal tin; it was almost immediately afterwards independently detected by Righi; it has been measured by him, and also

by Tomlinson; it has been made by Leduc and others the basis of a method of measuring the intensity of magnetic fields. Of the fact there can be no doubt. Neither can there be any doubt that when a wire of iron, or of bismuth or any other metal carries a current, a magnetic field is created circularly around the wire, partly outside it, also partly inside it. Also the intensity of this circular magnetic field within the metal depends upon the strength of the current. Hence it is *absolutely certain* that the resistance which an iron wire or a bismuth wire offers to a large current, is different from the resistance which it offers to a small current.

But shall we, because we find that resistance is a function of another variable besides temperature, forthwith pronounce Ohm's law false? Surely the more rational mode of procedure is simply to acknowledge that resistance is not a constant.

CORRESPONDENCE.

CHICAGO.

A Large Building and Isolated Plant.—Successful Storage Battery Cars.—An Electric Road Strike.—Mules vs. Motors.

ONE of the largest buildings in the world is to be built in Chicago. It is to be the new Fair building, which will be erected at State, Adams and Dearborn streets. The building will have a front of 190 feet on State street, 350 on Adams and 190 on Dearborn street. It will be of steel construction, the front of stone and terra cotta, sixteen stories high, and cost at least $3,000,000. Forty-three elevators will run in the building. A grand entrance will extend from State to Dearborn street, and another will run from Adams street to the main passage through the building. There will be an open court through the centre. The building is to be fireproof throughout, and will be lighted entirely by a private electric lighting plant, in the construction of which the latest improvements will be installed and no expense spared in making it one of the finest isolated plants in existence.

The report comes from Dubuque, Ia., that the electric storage battery system for running street cars has been tried there with such success that the president of the street railway company has ordered fifteen cars. Parties from Chicago, Milwaukee, St. Paul, LaCrosse and Indianapolis are expected there to witness tests of the system. The trial trip gave entire satisfaction.

The engineers of the White Line Electric Road at Dayton, O., ran all the cars to the north end of the line, last week, and then struck for an advance to $2 per day and demanded the removal of the recently appointed manager, Michael A. Nipgen, who was appointed to bring the employés into better discipline. The strikers grounded the wires and refused to allow cars to be run back to the power house.

A hard fight between mules and electricity is being waged by the street car companies in Springfield, Ill. This city has two street car lines. One is operated by mules the size of jack rabbits and is a narrow gauge affair; the other has recently substituted electricity for horse power. Citizens getting a taste of rapid transit petitioned the latter company to build considerable new road. Work was begun, but the mule line had previously secured a right of way from the city council over the streets on which the electric company attempted to build. There was a clash of forces and there has been war ever since. The electric company has succeeded in getting several miles of track down in spite of the opposition, the citizens along the route doing a good part of the work themselves. The city council decided that the "mule line" had the right of way, but the electric company declined to abide by the decision. The mule line has promised to put in an electric plant and put the road in position for rapid transit at once.

The demand for nine hours made by the machinists of Pittsburgh has gone into effect. At nearly all the shops the demands were granted, but about 500 men are out at shops where the demands were refused. Among the strikers are the machinists of the Westinghouse Machine Co. It is thought the trouble will be amicably settled in a few days.

A noisy debate occurred last week over the order to extend the time for the completion of the John B. Lyon electric railway on Stony Island avenue for one year. Aldermen Hummel and Gorman had some difficulty in getting a vote on their order. It was finally passed.

The disastrous fire which occurred about 6:30 p. m. on the evening of July 30, at the Ed. E. Ayer Company's yard, destroyed between 80,000 and 90,000 poles, making an estimate loss of $200,000, fully covered by insurance. This was the only available supply of poles in the vicinity of Chicago, and one of the largest in the country, and the loss will probably mean a scarcity and higher prices on poles for electrical work in the immediate neighborhood.

CHICAGO, Aug. 15, 1890.

PITTSBURGH.

Lighting a New Theatre.—Street Railway Projects.—An Electric Car Safety Device.

CHARLES L. DAVIS, who is "Alvin Joslin" of the stage, is to manage a theatre in Pittsburgh, next season. Mr Davis is evidently aware of the fact that electricity is the best illuminant for a theatre, and already he has contracted for the fitting up of his establishment with a complete electric lighting system.

Street car projects and rumors relating thereto are just about as plentiful in and about Pittsburgh as will autumn leaves be a month hence in the forests. The latest story is to the effect that the Duquesne Traction Co., which is now constructing a line from the heart of Pittsburgh to the East End suburbs, is desirous of gobbling the two big Allegheny City companies, the Pittsburgh, Allegheny and Manchester and the Pleasant Valley. Each of these concerns covers a large and profitable field. Each is pretty well backed by money and political influence, and it is not at all likely that either will sell to the Duquesne people at a sacrifice. The Duquesne company will have a large business itself, once it gets fairly under way with the running of its cars.

The Standard Underground Cable Company of this city are in a happy mood just now. Their joy arises from the fact that with them business is very active. They are just shipping a big order to Minneapolis and a bigger one to New York City, and many other cities of the country are appreciative of the Standard Company's goods.

The Enterprise Light, Power and Heat Company was organized at McKeesport, Pa., the other day. The intention is to erect a first-class station in Reynoldton, just across the Youghiogheny river from McKeesport. Reynoldton is a rapidly growing town, and is not provided with electric illumination. The officers of the new company are J. E. White, president; Thomas Reynolds, treasurer; L. G. Reiber, secretary; H. H. Swaney, solicitor.

There is considerable talk of an electric street railway between East Liberty and Braddock, to parallel the Pennsylvania Railroad, and of course take from that worthy corporation a portion of its patronage. It will be natural for the Pennsylvania people to look the reverse of smilingly upon this scheme, and they will probably do their best to squelch it. While waiting developments the sympathy of the public will be with the would-be organizers of the street car system, as a matter of course. Accommodations such as the proposed company would offer are ever welcome.

"The adjustable life saving guard for street cars" is the name of a contrivance recently invented by a resident of Pittsburgh named W. Y. Brady. Mr. Brady says his device consists of a series of pliable bars, covered with leather and resting on iron shoes, which when lowered will run close to the ground and receive on it any impediment the car may strike. While there is no claim that the use of this invention would prevent accident, the inventor is very certain that a car provided with it would be very much less likely to cause serious injury to a person or animal coming in its way.

PITTSBURGH, August 16, 1890.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.
Anonymous communications cannot be noticed.
The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.
In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.
Sketches and drawings for illustrations should be on separate pieces of paper.
All communications should be addressed EDITOR OF THE ELECTRICAL ENGINEER, *150 Broadway, New York city.*

EFFICIENCY OF THE TRANSFORMER.

[134.]—Mr. Swinburne's letter in the Aug. 6 issue of THE ELECTRICAL ENGINEER, with regard to the results obtained by Mr. Merritt and myself and Messrs. Humphrey and Powell, that have been communicated to the American Institute of Electrical Engineers and reported by you, is as kind as it is just.

In determining the instantaneous currents in the primary of the transformer Mr. Merritt and I used the following method: Two lamps were selected to be used in the primary of the transformer and "calibrated" for this purpose by subjecting them to different continuous differences of potential, and observing the corresponding strengths of current that were set up through them. From these observations, then, as data, a curve was determined from which we could read the resistances of the lamps corresponding to any difference of potential throughout the range through which they might be used. The lamps were then used in the primary of the transformer in the manner described in the paper.

When a curve of the differences of potential about the lamps that were caused by the primary currents producing falls of potential through them, was determined, the effective difference

of potential was also observed with the electrometer by connecting it direct to their terminals. This effective difference of potential could also be obtained from the same curve of instantaneous values of differences of potential, the two determinations making an excellent check. Then by reference to the curve of calibration the resistance of the lamps was obtained corresponding to the effective difference of potential, assuming thereby that the resistance of the lamps was the same, whether the lamps were subjected to a certain continuous difference of potential or the same numerical effective difference of potential. The ordinates of the curve of instantaneous differences of potential about the lamps were then divided by this value of the above resistance, when the resulting curve was the curve of primary current. I trust I have thus made clear beyond all doubt what we did.

The correctness of the method then is dependent upon the assumption that the temperature, and, therefore, the resistances, of the lamp filaments remain constant throughout a complete cycle, and from cycle to cycle.

Messrs. Humphrey and Powell, in their thesis work at the close of the last University year, did a large amount of experimental work for the purpose of procuring data that should be checked by students that would come after them, and that ultimately, therefore, would become valuable information for purposes of instruction. They considered the abstract of a portion of their work that they prepared to read before the American Institute of Electrical Engineers incomplete without a determination of cards of static hysteresis, and of hysteresis and Foucault currents combined, at the periodicity the transformer was worked. These cards they produced in great haste, and by them made the deductions to which Mr. Swinburne calls attention, and incorporated the same in the paper. They sent their papers to the secretary of the Institute to be reported and to have copies prepared for the meeting, and then discovered an error in the determination of these cards. It was then too late to remedy the matter. For these reasons then the plates XII., XIII. and XIV., containing comparisons and deductions from these cards in their paper, are erroneous and will be stricken from the authorized report of the Institute.

The hysteresis loss that Mr. Merritt and I found in the core of the 10-light transformer at a maximum magnetization of 3,850 lines per sq. cm. was 3,300 ergs per cycle per cu. cm., while Ewing's values given for very soft wrought iron, at this same maximum magnetization, show a loss of about 1,500 ergs, or, roughly, half what we obtained. It is not clear, therefore, why Mr. Swinburne should say that the loss that we found is small.

The other points of which Mr. Swinburne makes mention seem to me to be open to discussion, and would be difficult to settle definitely without more accurate experimental data than we have thus far been able to obtain.

HARRIS J. RYAN.

SIBLEY COLLEGE, CORNELL UNIVERSITY, ITHACA, N. Y., AUG. 11, 1890.

ELECTRICAL NOMENCLATURE.

[135.]—At the regular monthly meeting of the American Institute of Electrical Engineers, held on June 17th last, a proposal was submitted to advocate the connection of the names of Franklin and Henry with the names of some electrical units, and in particular to connect that of Henry with the unit of self-induction. I venture to think that this proposal deserves attention. The British Association Committee on Electrical Standards committed itself last year to the adoption of the term *quadrant* as a name for a practical unit of self-induction, and in face of the fact that private enterprise had already coined and set in circulation the name "secohm" for that of a practical unit of the same nature. Both these terms involve a departure from the principle first suggested by Mr. Latimer Clark and Sir Charles Bright in 1861, and adopted by the British Association Committee in 1862, of forming the names of practical units out of the surnames of distinguished investigators.

Objection has been taken to the term "quadrant" in that it conveys the notion of *a length*, and that it is not desirable that the name of a unit should convey the idea of its dimensions on a particular system of measurement, which now is, but to-morrow may be replaced by some other mode. I will not discuss the *pros* and *cons* of this point, but limit myself to the suggestion that the practical unit of self-induction in the system of measurement which employs the ampere, volt, and ohm, etc., as units, should be called a *hen*. Henry first actually observed the effect and invented the term "self-induction," and used it in a memoir published in the *American Journal of Science*, in July, 1832; whilst the account of Faraday's investigations on the extra current was not published until December, 1834. Henry has, therefore, every claim to be considered as the discoverer of the fact and the inventor of the name; and in employing this short monosyllable for the name of that practical unit, we shall do justice to his work, and bestow upon the unit a name which carries no suggestion of dimensions, and which is susceptible of being used in such compounds as *microhen* and *millihen*, convenient for subdivisions of the unit. There is nothing to prevent any one from speaking of true *hens*, or legal *hens*, or British Association *hens*, if it is required to be very precise. Instruments for the measurement of self-induction would be appropriately called *henmeters*, and the act of measurement *henometry*. There is more difficulty in recognizing the mode in which to embalm the name of Franklin; but I desire to point out that, if a place should be found for him in our Pantheon of units, there is yet another, namely, Gilbert, who deserves not to be forgotten. With diffidence I offer some suggestions on a magnetic nomenclature which will give opportunity to use them both. We want two practical units: One of magnetic induction, and the other of magneto-motive force (M. M. F.).

It may be questioned whether our time-honored phrase, "number of lines of magnetic force" (or of induction), is entirely satisfactory from a practical point of view. The machinery of tubes of induction, surface integrals, etc., is admirable for its purpose, but it is much more suited to the class room than the workshop.

It is also equally open to question whether the conceptions of magnetic force and magnetic induction derived from ideal visits to imaginary and exquisitely narrow crevasses in magnetized iron, the explorer being furnished with tiny imaginary "free poles" for experimental purposes, are of a nature best suited to assist actual magnetic engineers. Let us suppose all this for the moment set one side, and adopting ideas well expounded by Mr. Bosanquet in the *Phil. Mag.* for 1883, Vol. XV., p. 205, consider only magnetic induction as something produced in the iron by magneto-motive force, just as current is produced in a circuit by electromotive force. Magneto-motive force is produced in a magnetic circuit by linking it with current-turns. Let us dismiss the term "magnetic resistance," objected to by some on the grounds that "resistance" involves ideas of dissipation of energy, and speak of the *magnetic pliability* of a magnetic circuit to indicate its capability of experiencing magnetic induction under impressed magneto-motive force.

Then, further, let it be granted that the total magnetic induction in a magnetic circuit is measured in *gilbs*, and that the gilb is the unit of magnetic induction, one gilb being equal to a hundred million C.-G.-S. units of induction, and being defined by the condition that a uniform rate of change of induction in a magnetic circuit of one gilb per second produces an electromotive force of one volt in an electric circuit linked with it. Let magneto-motive force or difference of magnetic potential along a magnetic circuit be measured in *franks* and let one frank be defined by the condition that a uniform slope of magnetic potential along a magnetic circuit of one frank per centimetre of length produces magnetic induction of one gilb per centimetre of cross-section in that circuit, when that circuit consists of material of unit pliability (permeability).

What is now called "the induction" (B) will be called "density of, or intensity of, induction," and be expressed by gilbs per square centimetre.

The magneto-motive force will be expressed in franks or microfranks, instead of $\frac{4\pi}{10}$ times the ampere-turns (one microfrank = 80 ampere-turns); and the general relation between the magnetic quantities will be that the density of the magnetic induction in a closed magnetic circuit uniformly acted upon by M. M. F. is proportional to the magneto-motive force per unit of length, and to the magnetic pliability of the material of that circuit.

Magnetic pliability is a constant quantity (taken as unity in measurement) for all non-magnetic circuits; but in ferro-magnetic circuits it is a function of the induction or of the magneto-motive force. Tables can be made out from the observations on permeability at various inductions, giving the pliability of different kinds of iron for magneto-motive forces of different magnitudes applied in particular ways.

Suppose, for example, that a ring is wrapped over with insulated wire, and that there are 100 turns of wire on it, and that a current of 8 amperes is sent through it; there are 800 ampere-turns, or 10 microfranks of magneto-motive force impressed on that closed magnetic circuit uniformly. Let the length of that annular solenoid be 100 centimetres. The slope of M. M. F. is $\frac{1}{10}$ microfrank per centimetre. Hence, if the ring is of wood or brass, for which magnetic pliability is unity, we have that the density of induction in the circuit is $\frac{1}{10}$ of a microgilb per square centimetre of cross section. If the ring is of soft iron, proper tables would tell us that the magnetic pliability of soft iron under an impressed magneto-motive force of $\frac{1}{10}$th microfrank per linear centimetre is 1,200 units, and hence that for such iron ring the density of induction is 120 microgilbs per square centimetre (12,000 C. G. S.).

If the iron ring has a cross-section of two square centimetres, and is wrapped over also with 10 turns of secondary wire, and the primary current is completely reversed in $\frac{1}{100}$th of a second, the rate of change of total induction through this secondary would be approximately 480,000 microgilbs per second, and create in the secondary a mean electromotive force of nearly half a volt during the time the uniform rate of change of induction was proceeding.

These rough suggestions will perhaps show that from a practical point of view calculations for dynamo and transformer work might be simplified by the use of such units. The employment of a properly simplified nomenclature for the magnetic units will be a gain, and some such modifications as I have attempted to suggest are wanted for workshop use. One cannot readily teach

workmen to handle formulæ bespattered with 4π and 10^8, μ and B; but the conception of ampere turns (80 of which constitute a unit) wrapped round an iron magnetic circuit, whether dynamo magnet or transformer core, acting to produce a certain density of something called induction (measured in gilbs), more or less according to the magnetic pliability of the material, grafts on to existing experience with electric currents, electric pressure, and electric resistance, and only wants a proper set of units and names to make it adapted for every day use. Perhaps some of your readers will give you their views on these matters.

J. A. FLEMING.

UNIVERSITY COLLEGE, LONDON.

REPORTS OF COMPANIES.

STOCKS AND BONDS.

SHELBINA, MO., has voted bonds for $5,000 for an electric light plant.

SHELTON, WASH.—Mr. W. D. Baldwin, the city clerk, reports that the town will bond itself for $20,000 for electric light plant, etc.

JERSEY CITY, N. J.—Lawrence S. Mott & Co., 115 Broadway New York, are offering $100,000 thirty-year first mortgage bonds of the Jersey City Electric Light Co. 5 per cent. of the par value of $500. The net earnings of the company since January, 1889, have, it is said, enabled it to declare semi-annual dividends of 3 per cent. on the capital stock. The net earnings are steadily increasing, and out of the undivided profits an annual sinking fund of not less than $3,000 is deposited with the New Jersey Title Guarantee and Trust Co.

DIVIDENDS.

HARTFORD, CONN.—The Hartford Electric Light Co. has declared a semi-annual dividend of 3 per cent.

FINANCIAL MARKET.

QUOTATIONS ON ELECTRICAL STOCKS.

Mr. F. Z. Maguire, Electrical Securities, of 18 Wall street, this city, reports the following quotations of August 9 from New York, Boston and Washington :—

NEW YORK.

	BID.		BID.
W. U. Tel. Co.	85¼	Edison Gen. Elec. Co.	105
American Tele. & Cable	88	Edison Gen. Co. Pef'd	94
Centl. & So. Amer.	155	Consol'd Elec. Lt. Co.	60
Mexican	205	Edison Illn'g Co. N. Y.	70
Com. Cable Co.	....	U. S. Elec. Lt. Co.	85
Postal Tel. Cable	85	North. Am. Phon'gph.	65

BOSTON.

	BID.		BID.
Thomson-Houston	51¼	Ft. Wayne Co.	12¼
" Pref'd.	25¼	Am. Bell	225
" Series C.	12	Erie	51
" " D.	6	New England	50
" Int. Co.	....	Mexican	.80
Thomson Welding Co.	..	Trop. American	..
Thomson Eu. Welding	91	Edison Phon'gph Doll	3¼

WASHINGTON.

	BID.		BID.
Penna. Telephone	26	U. S. Elec. Lt. (Wash)	150
Ches & Pot. Telephone	78*	Eck. & Sold. Home	....
Amer. Graphophone	15	Elec. Ry.	68

*Ex. Dividend.

PITTSBURGH.

	BID.
Westinghouse Electric Manufacturing Co.	38¼

THE FRANKFORT INTERNATIONAL ELECTRICAL EXHIBITION.

Visitors to Frankfort will recall the magnificent Central railway station, situated not far from the city and separated from it by a campagna-like stretch of country. Here is an area of more than fourteen acres of waste land, on which the coming electrical exhibition is to be held. Leaving town by the Kaiserstrasse, electric railway trains will convey visitors to an electrical station situated between the principal building and the river annex. It is intended to apply some water-power in the Taurus forest 10 or 15 miles distant, to turbines of 300 h. p., which the Allgemeine Elektrizitäts Gesellschaft of Berlin, with the Oerlikon Works of Zurich, have offered to erect, with necessary dynamos, etc., on the Neckar river, provided some one else will furnish 108 miles of copper conductor of five millimetres diameter. This will be carried on overhead posts, and afford an excellent opportunity to study and experiment upon the subject of long distance transmission. Electric pumps will be employed to raise from the river the water needed for miscellaneous use; electric boat propulsion will be displayed, as well as every known application to power, light, etc.

METAL AND SUPPLY MARKET.

PRICES OF COPPER, ETC.

There has practically been no change of price in copper during the past week, and there is little to report save quiet and steady buying.

Following are the prices to which margins are being called, compared with those of a week and a year ago, as taken from the official circular :

	August 15.	August 8, 1890.	August 16, 1889.
Straits tin, spot	20.95	20.90	20.15
Straits tin, Nov	20.95	20.90	20.00
Lake copper, Aug	16.85	16.80	12.00
G. M. copper, Aug	—	—	—
Domestic lead, spot	4.60	4.45	3.92½
Domestic spelter, Aug	5.40	5.40	—

SOME "MUNICIPAL PLANT" FIGURES FROM MARIETTA, O.

Quite a discussion has sprung up recently as to the relative cost of electric lighting at Parkersburg, Va. (local company), and Marietta, O. (municipal plant), the two places being only 12 miles apart and operating under exactly the same conditions. The Parkersburg *Journal* gives a neat summary of the statistics brought out, as follows :—"The published reports of the cost of running the electric lights at Marietta, Ohio, for one year ($1,825), and our comments on the same, have called out further comments by the Marietta *Register*, which says :—'But, while the sum of expenses for salaries, repairs, etc., is about $1,850, there are two items, at least, not considered—interest on the bonds and depreciation on the plant. We believe our plant has been carefully handled and not strained. Still, 10 per cent. per annum on such equipments is not too much. It is great for the engine or the dynamo, but not enough for the wire. Add these to this cash outlay of interest and expenses, and it will run the cost up to about or quite $3,600. Parkersburg runs all night; we run to midnight, and not at all in full moon.' Yes; and investigation discloses the fact that Mr. Hancock, the superintendent, worked the first year without pay, and that hereafter he is to get $840 a year. The Marietta plant furnished 1,650 hours of lighting, an average of 4½ hours per day, as against 4,069, an average of 11¼ hours per day at Parkersburg. Marietta also uses city prisoners for handling coal, etc. Taking the *Register's* figures of $3,600 for last year, and adding the superintendent's salary, etc., we get the cost for an average year, for 61 lights (not 67 lights, since 6 were only recently added), at $4,500. Parkersburg has 58 lights, costing $6,264. But this includes $12 a year for each patent mast arm, which the city can drop at the end of three years from date of contract, if it so desires. But taking the cost at $4,500 for Marietta and $6,264 for Parkersburg, and reducing this to the cost per lamp per hour, we find that Marietta is paying 4½ cents per lamp per hour against Parkersburg's 2⅝ cents per lamp per hour. If we properly exempt the mast arm rentals, Parkersburg is paying 2⅓ cents per lamp per hour. This showing for the Parkersburg Company puts quite a different phase on the matter if the Marietta *Register* gives the correct basis to figure on, *plus* the superintendent's salary. Officials of the Parkersburg plant think that, on a fair estimate for expense, the cost per hour per lamp (61 lamps) at Marietta would be 2¾ cents."

IN BED WITH ELECTRICITY.

"We can give a point to New York people about getting their money's worth out of these little movable electric-bulb lights," said a visiting Idahoan the other day to a reporter of the New York *Times*. "Out our way we take them to bed with us. For keeping one comfortable on a cold night they are as good as a roaring fire in a room. Rubber bags, tin boilers and other devices for holding hot water get cold. With the thermometer 40° below zero, as we often have it in Idaho for long stretches at a time, these old-fashioned arrangements would freeze before morning. But the electric bulbs keep one snug and warm all the time. When I begin to get ready for bed I put the light between the sheets. By shifting it about every little while it takes the chill from the bed by the time I am undressed. As I slide in I push the light down with my feet, and usually fall asleep with it there."

LEGAL NOTES.

THE BRUSH COMPOUND WINDING PATENT ANNULLED IN ENGLAND.

KING, BROWN & CO. *vs.* ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION

In the Court of Session, Edinburgh, on Wednesday, July 16, the First Division disposed of a reclaiming note in the above case. It was originally brought in the Outer House by King, Brown & Co., Rosebank Electric Works, Edinburgh, against the Anglo-American Brush Electric Light Corporation, London and Edinburg, for reduction of letters patent granted to Mr. Brush in 1878 for the exclusive right of making dynamo-electric machines of the compound winding type. Lord Trayner, in the Outer House, found that Brush's patent, having been anticipated by Varley, was invalid, and he, therefore, decided the case in favor of the pursuers, with expenses. The defenders reclaimed to the First Division of the Court and the case was heard before the Lord President, Lord Adam, and Lord McLaren. Judgment on the reclaiming note was given sustaining the action of the lower Court, annulling the patent.

THE GAULARD AND GIBBS PATENT ANNULLED IN ENGLAND.

GIBBS AND OTHERS *vs.* FERRANTI.

In the House of Lords, on July 24, the case of Gibbs and Others *vs.* Ferranti came before the Lord Chancellor, Lord Herschell, and Lord Morris, in the form of an appeal by Mr. John Dixon Gibbs and the National Company for the Distribution of Electricity by Secondary Generators (Limited) from the decision of the Court of Appeal affirming the judgment of Mr. Justice Kekewich, who, on a petition presented by Mr. Sebastian Ziani de Ferranti, ordered that the Gaulard and Gibbs patent, No. 4,362 A.D., 1882, should be revoked.

Their Lordships said they were of opinion that the decisions of the Courts below were correct; and, therefore, they dismissed the appeal, with costs.

DOUBLE CARBON LAMPS.—BRUSH ELECTRIC CO. *vs.* WESTERN ELECTRIC CO.

We are in receipt of the following telegraphic dispatch from the Brush Electric Co., of Cleveland:—"Judges Brown and Ricks, on final hearing, filed an opinion to-day at Toledo, in our double carbon lamp case against the Western Electric Co., sustaining the Brush patent, granting injunction, and ordering an accounting for infringement."

ELECTRIC HAND-LIGHTING GAS BURNERS.—NOTICE ISSUED TO THE TRADE.

The following notification has just been put forth by the Electric Gas Lighting Co., of Boston, and A. L. Bogart, of this city, to manufacturers, users of and dealers in electric hand-lighting gas burners:—

You were notified on or about May 10th, 1888, of the acquisition by the undersigned of certain U. S. Letters Patent for Electric Hand-lighting Gas Burners, and of the commencement of certain suits against specified parties to establish the validity of said patents, and you were warned against infringement thereof, and that infringers would be exposed and prosecuted by the undersigned jointly.

This is to further notify you that in the first one of said suits to be decided, being the suit brought by us against the firm of Fuller, Holtzer & Co., in the U. S. Circuit Court, Massachusetts, upon U. S. Letters Patent, No. 225,071 to Packard, and No. 232,304 to Sanford, wherein the defences of want of invention and non-infrigement were thoroughly presented to the Court, a decree was on May 2, 1890, ordered for complainants, and an application for rehearing therein was, after full argument, on August 9, 1890, denied by the Court.

It has now been established that Electric Hand-Lighting Gas Burners, having a fixed electrode, a ratchet upon the valve-stem, whose teeth are proportioned in number to the ways in the cock, an angle-lever fitted loosely upon the stem, one arm for operating, and the other carrying an electric contact point past the burner-tip, a pawl attached to the lever, and engaging with the ratchet, a spring to retract the lever when released, and a stop-pin; and Electric Hand-Lighting Gas Burners having devices for opening and closing the gas passage at each alternate movement, and conjointly igniting the gas by an electric spark thus generated, with further devices which, without actuating the gas-cock, shall repeat the electrical spark by the return of the opening devices to their normal position, are protected by Letters Patent owned by the undersigned.

The trade is respectfully cautioned that all infringers will be held to account and pay damages.

INVENTORS' RECORD.

Patents issued August 12.

Alarms and Signals:—*Signal*, W. C. Paul and O. D. Kleinsteuber, 433,959.

Conductors, Conduits and Insulators:—*Electric Conductor Terminal*, C. A. Lieb, 433,948. *Machine for Covering Insulated Conductors with Lead*, L. W. Tracy, 434,007 and 434,008. *Underground Electric Conduit*, F. G. C. Zöpke, 434,076. *Electric Insulator*, J. K. Dunbar, 434,144. *Subway for Electric Conductors*, G. Westinghouse, Jr., 434,165.

Distribution:—*System of Electrical Distribution*, O. B. Shallenberger and H. M. Byllesby, 434,162.

Dynamos and Motors:—*Vertically-Adjustable Dynamo Support*, T. Wrigley, 434,011. *Rotating Part of Dynamos and Motors*, E. A. Sperry, 434,096. *Armature for Dynamos*, A. Schmid, 434,206.

Lamps and Appurtenances:—*Automatic Electric-Lamp Hanger and Switch*, O. B. White, 434,088. *Incandescent Lamp Socket*, P. Lange, 434,158 *Incandescent Electric Lamp*, A. L. Reinmann, 434,159. *Electric-Arc Lamp* W. E. Cady, 434,175.

Measurement:—*Ammeter and Voltmeter*, G. Pfannkuche, 434,082.

Medical and Surgical:—*Electro-Therapeutic Appliance*, G. Monrath and W. M. Gibbons, 434,024.

Metal-Working:—*Method of Welding Metals by Electricity*, H. E. Fowler, 434,017. *Method of and Apparatus for Burning Holes in Metal*, W. P. Kookogey, 434,188.

Miscellaneous:—*Coin Freed or Actuated Machine*, A. Harris, 434,109. *Cut-Out and Connection for Electrical Apparatus*, C. J. Klein, 434,149. *Switch for Electric Circuits*, P. Lange, 434,151 and 434,152. *Electric Indicator*, P. Lange, 434,154. *Protector for Electric Machines*, L. B. Stilwell, 434,163. *Core for Electrical Apparatus*, C. A. Terry, 434,164. *Electric-Arc Interrupter*, A. Wurtz, 434,166. *Lightning Arrester*, A. Wurtz, 434,167. *Safety Fuse for Electric Circuits*, A. Wurtz, 434,168. *Electric Safety Fuse-Box*, A. Wurtz, 434,169. *Lightning Arrester*, A. Wurtz, 434,170 and 434,371. *Electro-Magnetic Clutch*, S. C. C. Currie, 434,382.

Railways and Appliances:—*Electric Railway*, R. M. Hunter, 434,080. *Trolley for Electric Railways*, J. H. Wehrle, 434,086. *Brake Mechanism for Electric Street Cars*, J. Illingworth and A. M. Baker, 434,068. *Electric Rail Connector*, C. A. Lieb, 434,087. *Power-Gearing for Vehicles*, E. A. Sperry, 434,097 and 434,098. *Electric Railway*, R. M. Hunter, 434,147. *Electrically-Propelled Vehicle*, R. M. Hunter, 434,148. *Device for the Adjustment and Testing of Electric Cars*, T. M. Foote, 434,181. *Electric Railway*, R. M. Hunter, 434,275. *Current-Collecting Device for Electric Cars*, R. M. Hunter, 434,276. *System of Transportation by Electricity in Mines*, E. A. Sperry, 434,368. *Electric Railway*, R. M. Hunter, 434,389, 434,390 and 434,391. *Closed Conduit for Electric Conductors*, C. J. Van Depoele, 434,410.

Secondary Batteries:—*Secondary Battery*, P. Schoop, 434,093. *Connector for Secondary Batteries*, J. K. Pumpelly, 434,199. *Secondary Battery*, H. Woodward, 434,224. *Method of Making Electrodes for Secondary Batteries*, P. Schoop, 434,301. *Secondary Battery*, G. W. Cochran, 434,376.

Telegraphs:—*Printing Telegraph*, T. M. Foote, 434,261.

Telephones and Apparatus:—*Telephone*, E. Davis, 433,981.

EXPIRING ELECTRICAL PATENTS.

Reported by F. B. Brock, *Patent Attorney*, 639 *F street, Washington, D. C.*

Expired in June, 1890.

Car Brake, G. En-Earl, 139,557. *Telegraph Pole*, McCarver, Athey & Jennings, 139,593. *Gas Lighting*, Mueller & Meier, 139,599. *Telegraph* Poles, J. P Tirrell, 139,630, June 3, 1873. *Exploding Apparatus*, G. M. Mowbray, 139,686 *Printing Telegraph*, H. D. Rogers, 139,690. *Gas Lighting*, J. Vansant, 139,692; W. A. Pitt, 139,811. *Thereapeutic Bath*, S. Russell, Jr., 139,819. *Annunciator*, G. W. Shawk, 139,826. *Lightning Rod*, J. H. Weston, 139,841, June 10, 1873. *Thermostat*, J. H. Guest, 139,958. *Fire Telegraph*, R. Carter, 140,011; Wright, Holley & Miles, 140,106, June 17, 1873. *Annunciator*, W. W. Foote, 140,129, June 24, 1873. *Printing Telegraph*, A. A. Knudson, 140,143. *Incrustation Electrical Apparatus*, A. T. Hay, 140,196. *Telegraph Pole*, H. Dodge, 140,255. *Relay and Sounder*, M. W. Goodyear, 140,266. *Regulator*, E. Maertens, 140,287, June 24, 1873.

List for July was printed in THE ELECTRICAL ENGINEER of July 2, p. 25.

Expiring in August, 1890.

Railway Signal, J. G. Smith, 141,604, August 5, 1873. *Railway Car Telegraph*, R. K. Boyle, 141,755. *Automatic Telegraph*, T. A. Edison, 141,772, 141,773, 141,774 and 141,776. *Perforating Telegraph*, T. A. Edison, 141,755. *Relay and Sounder*, T. A. Edison, 141,777, August 12, 1873. *Annunciator*, A. Storer, 141,898 *Relay and Sounder*, H. Van Hoevenbergh, 141,966, August 19, 1873. *Telegraph Pole*, J. L. Chapman, 142,082. *Railway Signal*, H. W. Spang, 142,131, August 26, 1873.

[Copies of drawings and specifications of any patent will be furnished by Mr. Brock, at 15 cents each.]

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

MARSHALL'S CONDENSERS.

Among the standard specialties of the electrical instrument field are the electrical condensers of Mr. Wm. Marshall, rooms 2 and 4, University Building, this city. Mr. Marshall, slowly but very surely, has built up an enviable reputation for his work, and we have ourselves on many occasions seen the quality of his condensers tested and triumphant under the most exacting conditions. His business was at one time limited to the telegraph, but he is now making and selling for telephone and electric light use. Recent orders are for two multiple series, for the Metropolitan Telephone Co., of half a microfarad each, divided in tenths and one microfarad in tenths for Columbia College. He has also received orders from the New York & New Jersey Telephone Co., the Brush Illuminating Co. and many others.

ELECTRIC CONSTRUCTION & SUPPLY CO.

The above company, of 18 Cortlandt street, have constructed a double carbon arc lamp, they report, embodying the principles of their well-known arc lamp for incandescent circuits. A large number of these lamps are now being made, and the company will be ready to fill orders in about a couple of weeks.

RUSSELL JOHNSON'S ELECTRIC LIGHT MOULDINGS.

One of the most familiar of the details of interior incandescent work is the moulding, and it would not be easy to say how many million feet have been made and used within the last seven or eight years. Mr. Russell Johnson, of 459-465 Cherry street, this city, has long made a specialty of the business, and has sold his product in enormous quantities to all the largest consumers. He has been established thirty or forty years in the lumber business, and when the electric lighting industry sprang up and the call came for mouldings, it was natural that he should enter the new field, not so much perhaps by design as by accident. Having thus secured a preemption on the business, he has ever since been actively engaged filling orders for mouldings in a large variety of sizes. Among a few of the installations he has supplied may be named Columbia College, the Metropolitan Museum of Art, and W. D. Rockefeller's country mansion at Tarrytown; as well as the U. S. war vessels, "Chicago," "Baltimore," "Philadelphia," "Yorktown," etc., as well as the steamers, "Venezuela," "Maryland," "Caraccas," and the beautiful Fall River boats, "Puritan" and "Plymouth." Mr. Johnson will send to any address his blue print sheet of sizes and shapes of mouldings, and has recently issued a very handsome wood mounted thermometer, a neat and ornamental reminder to his patrons.

THE SCHEFBAUER SMALL ARC LAMP.

Mr. R. Schefbauer, of Paterson, N. J., has transferred his business and experimental shop to 28-30 Centre street, this city, and there formed a connection with the old and reliable manufacturer, Mr. A. Wirsching, of ticker fame, for the purpose of manufacturing their various electrical specialties in the latter's well appointed establishment. They will operate under the firm name of Schefbauer & Co. They will pay special attention to Mr. Schefbauer's patent electric cigar lighter, which was fully described in our issue of July 30, page 106, and for which they are already in receipt, as a result thereof, of large orders from all parts of the country. Their announcement with regard to this excellent novelty will be found in our advertising pages. The lamp ranges from 80 to 200 c. p., and is extremely economical in its operation. There is a large field and future before it.

THE SHAVER TELEPHONE SYSTEM.

Mr. George Frederick Shaver, the indefatigable delver in the mysteries of molecular vibration, has recently added another improvement to that remarkable instrument, his Molecular Telephone. It consists of a dish-shaped sounding board, to the concave side of which is secured the diaphragm and molecular resonator previously described in these columns. The strain of the line wire is imparted to the arched sounding board, producing an effect analogous to that of the sounding board of a violin. In practice the device adds materially to the power of the instrument, while the articulation leaves nothing to be desired.

Four sub-companies have been recently organized in New Hampshire, with head-quarters at Berlin Falls, Littleton, Bristol and Concord, and exchanges are being erected. The Shaver Corporation are being overrun with orders, and bank systems and trunk lines are being built in many sections of the country. Plainview, Minn., has, it is stated, thrown out its Bell telephones, and is now getting good telephone service over an extensive molecular trunk line system, connecting the varous business houses, etc. The plant was erected by Mr. J. B. Soboleski, agent of the C. & N. W. R. R. at Plainview, who claims that the service is superior to that with electric telephones.

MILLIKEN RAILWAY POLES.

Lemuel Wm. Serrell, M. E. of 115 Broadway, N. Y., tells us he is meeting with great success in selling the Milliken patent pole for electric railways. He says that he recently closed with Murray Verner, of the Verner-McKee syndicate, for poles for the entire city of Buffalo. He has already received orders from the Rapid Transit St. Ry. Co., Newark, N. J.; Troy & Lansingburgh St. Ry. Co., Troy, N. Y.; Essex Passenger Ry. Co., Newark, N. J.; Buffalo St. Ry. Co., Buffalo, N. Y.; Pittsburgh & Birmingham Traction Co., Pittsburgh, Pa.; Passaic, Garfield & Clifton St. Ry. Co., Passaic, N. J., and Jersey City & Bergen St. Ry. Co., Jersey City, N. J. He has taken orders for over 6000 poles during the last three months.

ABENDROTH & ROOT BOILERS.

The Abendroth & Root Manufacturing Co., 28 Cliff street, New York City, find a good demand for both their new water-tube sectional safety boiler and their spiral riveted pipe. The new form of Root boiler is well adapted and very popular for electric lighting and power stations, being a rapid steam generator, economical in the use of fuel and easily managed. We notice that the manufacturers are making some large shipments to Cuba.

THE OKONITE CO.

The large orders recently received by the Okonite Co. have kept their force at their new Passaic factory very busy. This establishment is thoroughly equipped with everything needful for the expeditious handling of a large business, and turns out an enormous quantity of Okonite insulated wire daily. Every facility is availed of by the company for the transportation of its goods, and taking it all in all the future of this enterprising concern looks very promising.

WESTON ELECTRICAL INSTRUMENT CO.

The Weston Electrical Instrument Company, manufacturers of the Weston portable direct-reading standard voltmeters and ammeters, are now thoroughly settled in their new factory, 114 William street, Newark, N. J., and very busy. The demand for these goods is becoming quite general and is due both to their general excellence and the enterprise manifested by the manufacturers.

JAMES J. MURRAY & CO.

The above well-known concern, proprietors of the Murray Flint Glass Works, Trenton avenue, Culvert and Waterloo streets, Philadelphia, report that they are now in full operation for the season of 1890 and 1891, and are producing a great many new features in goods for electric lighting. Philadelphia is not far from Cape May, and the firm would be pleased to have any of the delegates to the convention favor them with a visit.

THE MILL & MINE ELECTRIC EQUIPMENT CO.

The above company, of 95 Fifth avenue, Pittsburgh, has lately been doing a quantity of heavy mine work. It is now increasing its capital from $10,000 to $100,000 to meet the orders offering it, and is in a position to handle mill and mine equipment in a prompt and satisfactory manner. W. J. Burns is president of the company; W. A. Giles, secretary and general manager, and W. B. Giles, treasurer.

TRIPLE SIGHT FEED DYNAMO OIL CUP.

The Wm. Powell & Co., of Cincinnati, have an excellent oil cup in their specialty named as above, and illustrated in their announcement in our advertising pages. It has been found very satisfactory by those engaged in the operation of dynamos. It is not only a sight feed but is very easy and simple to handle, regulates to a nicety, is of neat appearance, and can be started or stopped at will. The company will be glad to send circulars and price lists to any address.

PITTSBURGH REDUCTION CO.

The Pittsburgh Reduction Co., of Pittsburgh, manufacturers of aluminum for commercial purposes, will erect a new plant near Pittsburgh. It is proposed to erect a plant with 10,000 h. p. near the natural gas or soft coal fields. The company at present occupy an iron-clad building 75 x 175 ft., and are running night and day.

A MAMMOTH SUPPLY HOUSE.

The slow but steady growth which has brought so many of the leading houses of to-day to the front sometimes seems to be eclipsed by the sudden arising of a new firm, which stands up, broad-shouldered, and in a few months gets a firm footing.

Yet the suddenness is only apparent, for the men back of such an enterprise must have been many years in gaining their experience which would enable them to hold their own and gain ground in the face of strong competition.

So it is with the young giant in the electric supply line, which, at the end of but a few months, commands the trade of a large share of the Western and Southern consumers. The step from the small yet influential supply house kept at 80 Adams street, Chicago, by Mr. Geo. Cutter, to the Great Western Supply Co.'s mammoth house at 190 and 192 Fifth avenue, was indeed an enormous stride. The more so as this is but one of the eight or more supply depots which will be controlled by this firm, while several large factories will give in their whole output. Yet a glimpse of the working of this firm will show that the master hands are up to their task, and that the routine of business is almost as smooth as with the older competitors. Truly a trip through such a house means a glance at the electrical business of to-day, or, rather, of the future, and has been duly appreciated by hundreds of our Western readers. We owe it to those not so near to Chicago, that we give them some idea of this house in our columns. The selection of a building for the Chicago house could hardly have been improved upon, both as to its location and as to the space, light and accessibility. Right in the middle of the block, between Monroe and Adams street, the electrical signs and window display on a double front building will attract the attention of the many passers-by. The 42 feet front gives ample window space, where the borders of colored and opalescent glass shades, the assortment of switches, batteries and small motors, as well as some electric light and railway goods, may be shown to advantage. The five high stories, with large windows in the front and back, give light and airy floors, and room for plenty of shelving.

The location is one that makes it the most accessible of Chicago's electric houses from any of the depots. Besides, it is but a block from the other great electrical beehive, "The Rookery," and but three blocks from the Chicago Electric Club. This, with the usual telegraph and telephone facilities, seems to make it convenient for everybody electrical.

On entering the store, any one of the number of novel features is apt to so catch one's eye that others of equal attractiveness may be passed by. To the left, near the door, is a large sample board setting off the brands of wire, as well as some of the choicest house goods. The double row of deep drawers extending along the south wall is surmounted by some four hundred pigeonholes, now mostly filled with small lots of the varied stock.

In front of these compartments is a line of some fifty feet of show cases, at present filled with station and linemen's tools, house goods and testing apparatus.

The oak railing shown in the foreground in our cut, gives a clear space for the managers of three departments and their assistants. The fan-motors shown on their desks give any desired amount of circulation, enabling the same amount of work to be done on hot as on cold days. Above this enclosure hangs a large elk-head electrolier, consisting of three deer heads, the tips of whose antlers are studded with incandescent lamps. A special form of attachment was devised for these, and the wires are practically concealed. Neat tinted shades add to the effect, which is as pleasing as it is novel.

A good part of the ceiling has parallel iron pipes run lengthwise of the store, a few feet apart. From these the electric and combination fixtures are suspended. Here are fixtures varying from plain electric pendants to large chandeliers, and representing the finest American and European designs. Toward the farther corner a hundred brackets set against a dark background are shown to advantage. Here, too, are several new and handsome designs of fixtures for electric car lamps, to which but little attention has heretofore been paid.

Beneath the brackets are sliding racks for incandescent shades, arranged to show a large number in a small space. The partition in the background of the cut separates the store from the shipping room, which, like nearly every other part of the building, is fitted with shelves and bins for storing goods. Here are thousands of the Bryant switches, yonder are bins filled with the Cutter porcelain cut-outs, while in the corner the freight elevator is in steady use.

In the basement one meets with hundreds of reels of Simplex and galvanized iron wire, while one wall is lined with cross-arms of various sizes. In the farther corner is a long shute, lined with iron, down which the reels of wire try their experiments in rapid transit. At the same time the elevator can be used for taking wire up, thus making the receiving independent of the shipping department. Incandescent lamps light up the rear of the basement, the building being wired throughout with Simplex T. Z. R. wire.

On the second floor are the offices of the company, of which our bird's-eye view shows a portion. They are conveniently arranged and handsomely finished in antique oak, with inlaid floors and chipped glass windows. The desks, cabinets and other furniture are all picked to give the greatest usefulness, and here the originality of those interested has been given full play.

Our illustration shows a glimpse of the manager's office, adjoining, while on the one hand is the stenographers' room, and on the other a private labratory where tests of various kinds are made. To the right are the bookkeeping room and the purchasing agent's office, with the directors' room and the clerk's room in the background. Handsome electric fixtures will soon adorn all these rooms, while an abundance of wall sockets enable lamps to be placed anywhere.

The rear of the same floor gives room for many hundred miles of K. K. wire, and also has a studio fitted up for photographing the new designs of fixtures, shades, etc., brought out by the firm. Close by the stairs is another space devoted to shades and arc globes of all styles. The third and fourth floors are used for storing goods, plenty of shelving and drawers being provided. The racks on the latter floor are said to contain the largest stock of shades in the West, and other lines of goods seem to be equally well represented.

On the top floor is the repair shop, and here, too, some of the company's specialties, like Cutter's street-hood or porcelain cut-out, are put together. This shop, added to the out of town factories controlled by the firm, enables it to make its own specialties in any quantity. What some of these are our readers will have already learned, for in its short career this house has brought out a number of articles which promise to stay.

As to the personnel of the new house, the manager, Mr. Geo. Cutter, needs no introduction to our readers. His twenty years experience in America and in Europe has given him a broad view of all electrical work, and enables him to judge well of the electrical supply line. He is assisted by Mr. Rea Pixson, who also acts as purchasing agent for the new firm. Mr. Charles G. Armstrong, well known from his connection with the New Haven Clock Co., and with the electrical work at the Auditorium, and for his numerous inventions, is at the head of the house goods department. Mr. Edwin R. Crolius, late of Sneider, Campbell & Co., has charge of the fixture department, while Mr. C. A. Robinson, buyer of the late Sprague Electric Equipment Co., takes special care of the railway supplies. Others of equal experience are directly or indirectly associated with the house, enabling every part of the work to be properly cared for.

SOME NEW WESTINGHOUSE PLANTS.

When the spirit of progress strikes a town, it is not long content without an electric light plant. Electric illumination is deemed a necessity wherever commercial activity is found. The South, as everybody knows, is developing rapidly at the present time and consequently in that region there is large demand for electric lighting apparatus. The Westinghouse Electric & Manufacturing Company has recently closed contracts for plants in three Georgia towns, Valdosta, Washington and Waycross. It is evident that the Empire State of the South is determined not to be distanced by its sisters.

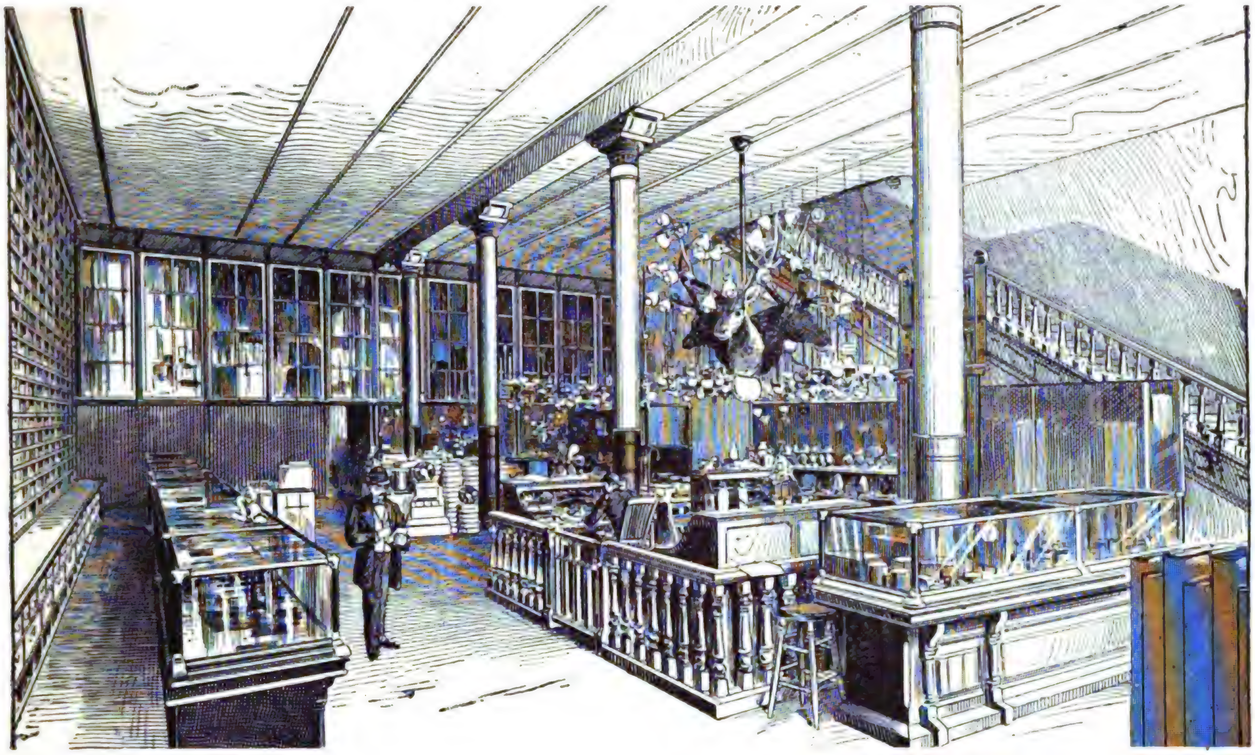
The Allentown Electric Light & Power Company, Allentown, Pa., which for some time has been using the Westinghouse alternate current system of incandescent lighting, has just placed an order with the Westinghouse Company for another machine, it being found necessary to increase the capacity of the plant to two thousand lights.

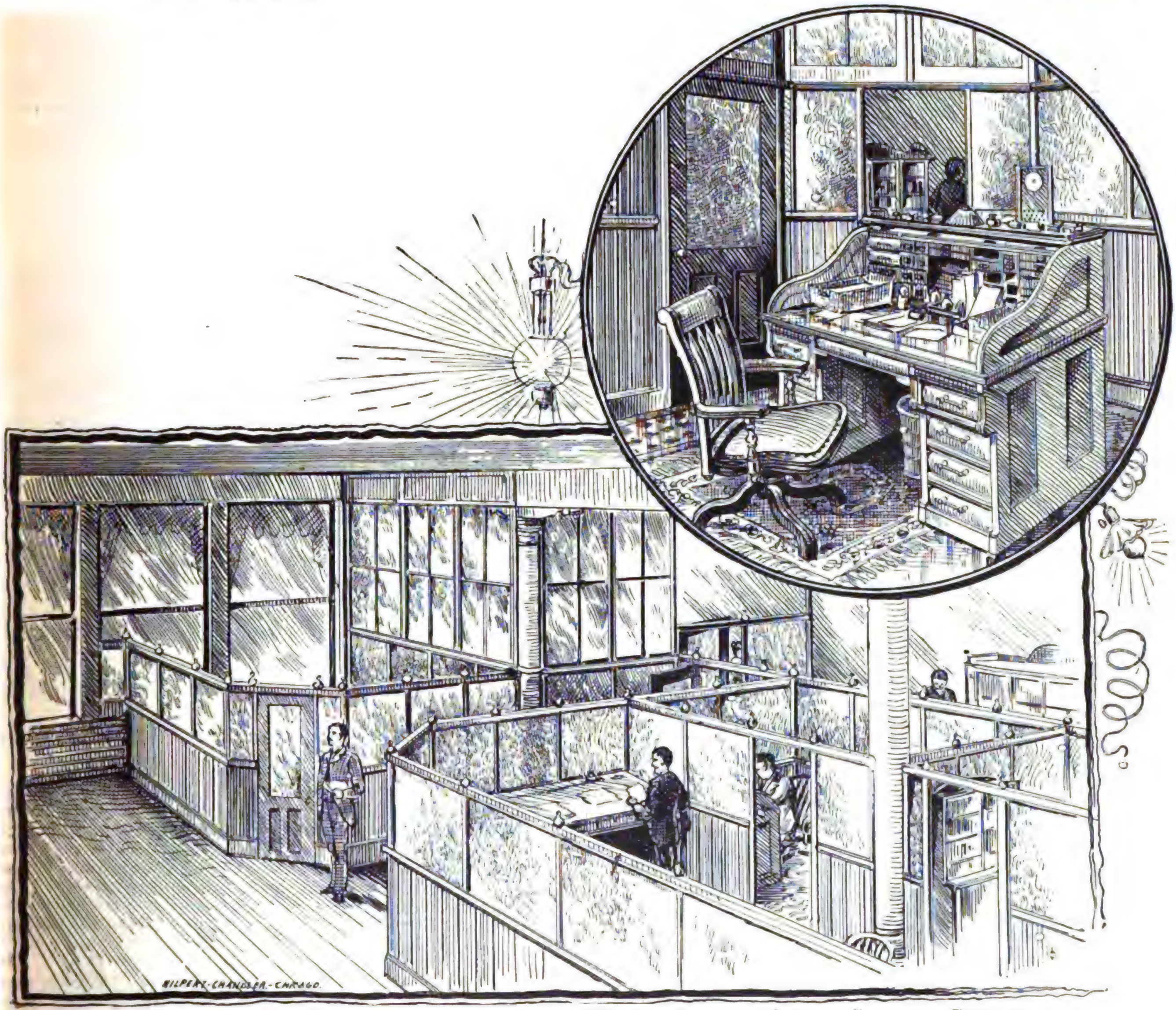
Media, Pa., seems to appreciate the electric light thoroughly. The Media Electric Light, Heat & Power Company has a fifteen hundred Westinghouse alternate current plant and is now ordering an additional five hundred light machine with a view to keeping up with the demands of its customers.

The Westinghouse alternate current incandescent system is being employed for central station lighting in every state and territory of the Union with the exception of the state of Nevada and the territory of Arizona. In the state of Texas, twenty lighting companies have seen fit to adopt the Westinghouse system. In Pennsylvania, the Westinghouse stations number very nearly forty.

JAMES W. QUEEN & CO.

Queen & Co., of Philadelphia, report a steady and increasing demand for their specialties in test instruments. Their improved portable testing sets are meeting well deserved favor, as new features of great value to electricians have been introduced. These sets are being made in large quantities to fill orders already received. The new "Magnetic Vane" ammeters and voltmeters, as brought out by the same firm, are much sought after, and are now in use by the Edison, Brush and Mather Companies. Meters of special size and range are made if desired. A large collection of instruments has been placed on exhibition at Cape May during the convention by Queen & Co., and all who are interested in the subject will be well repaid by a visit to their parlor, where every-one will be welcome.





FIGS. 1 AND 2.—DEPARTMENTS OF THE GREAT WESTERN ELECTRIC SUPPLY COMPANY, CHICAGO.

THE KELSEY RAILROAD SIGNAL CO.

The Kelsey Railroad Signal Co., of Florence, Mass., has equipped the north bound track through the New York Central tunnel from 59th to 86th streets with six audible signals; three one blow indicator signals stationed 300 ft. in advance of home signal locate the latter in case of fog or smoke. The home signals have the company's gong attachment, which rings only when signals are at danger. The company has also finished a very compact three lever interlocking ground machine, built to operate drawbridge lock, home and distant signals, derail switch and switch lock. The machine has also automatic two wire compensator. Its height from floor to to top of signals is 27 inches; width over all, 23 inches.

THE INTERIOR CONDUIT SYSTEM.

The Interior Conduit and Insulation Co., of 16 and 18 Broad street, will issue for the Cape May convention, a pamphlet of testimonials as to the merits of their system. It will embrace endorsements by the various electric light companies, wiring contractors, insurance inspectors, boards of fire underwriters, architects, builders and others. It will also have fac simile letters from J. Pierpont Morgan, E. H. Johnson, T. A. Edison, and Elihu Thomson. It will be quite an interesting book as a description of the system and a pleasant souvenir of Cape May.

EXCELSIOR ELECTRIC CO.

The Excelsior Electric Co., of 115 Broadway, have been experiencing a very large demand for the new Hochhausen arc dynamo illustrated and described in THE ELECTRICAL ENGINEER of April 23. It has proved an immense success in every way. Machines of that type have now been placed in the stations at Kansas City, Kan. (2); St. Charles, Mo., city plant (3); Chicago Arc Light and Power Co.; Plymouth, Pa., Electric Light and Power Co.; Mt. Morris Electric Light Co., New York City; P. J. Walsh, Philadelphia (2); Murphysboro, Ill.; Harrisburg, Pa.; Merchants' Electric Light and Power Co., Chicago; Harrison, N. J., Electric Light Co.; City of Ottawa, Ill., 100 lights, and an increase of 50 more; Osage City, Kan., 50 lights; Duluth, Minn., 50 lights; St. Joseph, Mo., 60 lights, and many more.

The company are also, Mr. Fuller states, extremely busy in their motor department, and are receiving a large number of orders. They are now making a 500 volt motor, which will be ready in about a month, and of which several will be placed immediately. The Excelsior motors are excellent machines, of correct design and high finish, and the reports that come from users are very satisfactory. A great many have already been installed in this city, but a large number are also in service all over the country.

EXECUTION BY CARBONIC ACID GAS.

Dr. Allan McLane Hamilton, who has studied and written since 1873 on the application of electricity to the human body, has, after many experiments, come to the conclusion that electrical execution is a humbug, and openly avows his belief that carbonic acid gas introduced secretly by concealed pipes into a lethal chamber would furnish the ideal of civilized extermination for murderers. "This is the same gas generated for soda fountains," says Dr. Hamilton, "and could be manufactured as easily and inexpensively for the State executioner as for the five-cent soda-water purveyor."

LIGHTING UP THE SEA IN FOGS.

An ingenious invention is described in *Engineering* for distinguishing and safeguarding vessels in fogs. It is based on the fact that when a fog hovers over water there is always a clear space of a few feet between the surface of the water and the bottom layer of the fog. Each vessel is to be provided on one side of its bow, just above its highest water line, with a horizontal row of glazed portholes, and on the opposite side with a vertical row of like holes. Electric lights are arranged to throw beams of light forward and laterally through these portholes, the different arrangement of which is to serve to show the course of the vessel. Sighting portholes, carrying telescopes, are also to be provided close to the former porthole.

THE CLAMBAKE OF THE YEAR.

It has been the custom of the American Electrical Works, through its estimable president, Mr. Eugene F. Phillips, to invite the electrical fraternity annually to a clambake at Providence, R. I., and the notices are now out for the twelfth "clam dinner." The scene of the festivities will be the Vue de l'Eau Club, and the date fixed is August 23, 1890. There will be lunch at 11:30, and the bake will be opened at 3. It is needless to say that the occasion, "rain or shine," will be one of great enjoyment. The Reception Committee are:—Marsden J. Perry, J. J. Carty, H. B. Cram, John I. Sabin E. B. Baker and W. H. Sawyer.

WESTERN TRADE NOTES.

MR. FOREE BAIN, the well known electrical expert and manufacturer, has gone to Kentucky on a short vacation.

THE EXCELSIOR ELECTRIC CO., 425 The Rookery, report the sale of a 100 arc light plant of their well-known system at Ottawa, Ill.

MR. P. C. ACKERMAN, the New York agent of the American Electric Works, of Providence, R. I., was recently in town on a short business trip.

MR. GEORGE H. R. PREBLE, who has been staying here for a couple of weeks and looking up electrical matters with special reference to electric street railway work, has returned to Tacoma, Wash.

THE WESTERN POWER CONSTRUCTION CO. are placing three McIntosh-Seymour standard high pressure engines of 200 normal horse-power each, but capable of developing if desired 300 horse-power each, in the Chicago Edison Company's central station on Adams street.

THE KNAPP ELECTRICAL WORKS are meeting with great success in selling American Electrical Work's line wire. Mr. Myron A. Knapp has gone East, and while away will take in the convention and the cool breezes of Cape May. He will return undoubtedly with many substantial proofs of the general favor in which his goods are held among the electrical fraternity.

THE GREAT WESTERN ELECTRIC SUPPLY CO., 190–192 Fifth avenue, who recently placed upon the market the "Lounsbury" combination pulley and lamp support, have just issued a neat little circular describing it and pointing out the advantages of this very useful adjunct to arc lighting. The mechanism and construction of this pulley was very fully described and illustrated in our columns recently.

J. LANG & CO., 44 Michigan street, Chicago, during the past week have shipped fifteen of the well-known Andrews and Lang switches to various parts of the country. Amongst recent orders they have received for switches are the following:—Six 400 ampere and seven 250 ampere Adams switches for Kansas City, six 100 ampere and six 250 ampere arcs for Chicago; and in Lang switches there are orders for seven double-pole 50 amperes, one double-pole 100 amperes, and ten ordinary 50 ampere ones.

MR. FOREE BAIN, 80 Market street, Chicago, the well-known electrical expert and manufacturer, has just completed an 100 horse-power machine of his new dynamo-motor type. The machine shows excellent mechanical and electrical design and its efficiency is remarkable. The magnetic circuit is so designed that the amount of wire and exciting current are both reduced to a minimum. This machine has just been tested with the most satisfactory results. Mr. Bain has an order for a 200 horse-power similar machine, which will be built right away.

THE CENTRAL ELECTRIC CO. are well fixed for orders and Okonite wire as usual is selling fast. In their handsome offices they have an arc lamp burning with a pleasant and steady light upon the incandescent circuit, and they state that these lamps are highly successful connected in this manner. Near by is one of their globe fans, operated by a Belding motor, which absolutely defies hot waves and maintains a regular lake breeze at all times. In general supplies they are doing a large business, as also with the various specialties which they handle.

THE ILLINOIS ELECTRIC MATERIAL CO., The Rookery, Chicago, dealers in electric light power and electric street railway supplies, have been appointed Western agents for the famous "Canvas Jacket" patent woven-covered insulated wires and cables, manufactured by the American Circular Loom Co., of Boston, Mass. This wire, although but recently placed upon the market, is being received with great favor on account of its remarkably high insulating qualities, and the enormous amount of abrasion that it will withstand. To the peculiar method of applying the covering, these features so desirable in line wire are due. This company has already sold several large lots in the West and fresh orders keep coming in.

THE WESTERN POWER CONSTRUCTION CO., 144 Adams street, Chicago, are installing a 200 horse-power high pressure McIntosh-Seymour engine in the Exposition Building on, Michigan Avenue, to run two large Edison generators for lighting the building, which will be illuminated with some 2000 incandescent lamps. This is one of the recent batch of six McIntosh-Seymour engines sold by this company to the Edison Company. Mr. W. P. Adams, enroute from St. Paul to Boston via Chicago, unfortunately got mixed up in a railway wreck and was delayed at Oneida, Ia. Such trifles as these, however, will not hinder him from being on hand at Cape May, and The Western Power Const. Co. will certainly be ably represented there by him.

☞ *For Departmental matter on Electric Light, Electric Railways, Electric Power, New Buildings, New Hotels, New Street Railroads, etc., etc., see the following advertisement pages.*

THE

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EDITORIAL ANNOUNCEMENTS

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed*, EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

VOL. X. NEW YORK, AUGUST 27, 1890. No. 121

The enthusiasm of the inventor and promoter is necessary to progress, and it seems almost to be a law of nature that it should overpass the bounds marked out by reason and experience.—Lord Rayleigh.

THE NATIONAL ELECTRIC LIGHT CONVENTION.

THE Association is in a fair way to win distinction, if not the championship, in carrying out Thomas Jefferson's idea of frequent Constitutional revision. Once in twenty years, we believe, was the period he would have set for an overhauling of the Constitution of the United States. Once a year has now become the practice of the National Electric Light Association. The revision accomplished at Cape May is the third in the yearly series. "Three times and out" is a time-honored saying, but we mistrust its application in the present instance. The motive of the revisions of 1889 and 1890 seems to be entirely just and wise, to wit: to secure the control of the Association and its action to central station men, a class in whose behalf and for whose benefit the Association was formed. That object seemed to be attained by the amended Constitution adopted at Niagara Falls a year ago; which left manufacturers, supply men and all other associate members in the possession of all the privileges of the Association except the right to vote. The Cape May revision diminishes the privileges of associate members by excluding them from attendance at "Executive Sessions," and limiting their participation in other meetings to the discussion of papers read before the Convention. A number of associate members felt that the proposed new Constitution was a direct affront to that class of members, indicating that their room would be more acceptable thenceforth than their company. All feeling of this kind was happily dispelled by the unanimous defeat of Dr. Mason's motion—submitted to gauge the sentiments of active members—striking out the clause of associate members altogether; and later, by including in their privileges the right of discussion on papers.

While it may be doubted whether the Association has yet achieved a satisfactory Constitution, it is quite clear that the owners and managers of central stations in its membership highly value the presence and co-operation of manufacturers, dealers, electrical engineers and others indirectly interested in electric light and power distribution and desire to avail themselves of their knowledge and experience. The Association will, perhaps, hardly throw off its now acquired habit of annual Constitutional revision at once; further attempts to reach a satisfactory status are not unlikely. The amendment offered by Mr. C. A. Brown, abolishing the class of associate members, making all persons now eligible to associate membership eligible to active membership, and providing a veto power in the control of central station men upon all legislative action, may be found to possess some merit as suggesting a method of giving non-central station men a more adequate standing than they now have in the Association, while preserving to the present class of active members satisfactory control of all action. If one-man power be objectionable, the veto might lie with the Executive Committee.

It is to be regretted that discussion was so frequently cut short at the Cape May meeting by resorting to tabling motions, etc. A fair field for all measures on important topics would seem the better policy.

THE SAFETY OF ELECTRICITY.

THE vague and irresponsible statements which have for a long time past been circulated, more particularly by the daily press, have had the effect of instilling into the minds of the uninformed the notion that the employés of electric light stations were subject to greater risks from accidents than those engaged in any other occupation, powder mills and dynamite factories not excepted. All attempts to counteract this feeling of distrust have heretofore been futile, and it is, therefore, a matter for congratulation that the electrical fraternity is now enabled to go before the public with a statement of the exact facts, in the shape of statistics gathered by an insurance company, whose desire to get at the correct figures can not be called in question. The result of the investigation undertaken by the Employer's Liability Assurance Corporation, as set forth in Prof. Morton's paper, read at Cape May, shows that out of 91 accidents reported in central stations only 15 were assignable to the effects of the current, the remaining ones being such as are constantly occurring in power-using establishments. But notwithstanding this excellent showing, the insurance company finds itself obliged, so it claims, to increase the rate of insurance 100 per cent., owing to the fact that people have been wrought to such a state of excitement that unbiased juries cannot be obtained. This hardly seems to us a valid explanation, in view of the fact

that the company has devised a set of rules which, if strictly carried out, would, as Prof. Morton shows, have prevented even the few accidents that did occur. When, as instanced by one of the members during the discussion, five years' operation of his station had not produced a single accident referable to the current, it is certainly a hardship to be subjected to an increased premium. It is to be hoped that the insuring company which has undertaken to exploit this field will recognize the unjust discrimination, and we incline to believe that the course taken in the future will be modeled to a large extent after that of the fire companies, and result in actual concessions to the employés of electric light stations conforming to, and strictly drilled in, the observance of the standard rules of safety. If this point is not reached, the electric light and power business will found an insurance agency of its own for the men engaged in it.

ELECTRIC MOTOR RATES.

In his admirable paper presented before the Cape May Convention, Mr. H. L. Lufkin has touched upon a subject which is of the highest importance to the managers of central stations at the present time. Comparatively few of those who are to-day renting power have had the time to make an accurate study of the conditions which obtain in various manufacturing or trade establishments, relative to the average amount of power consumed. The instructive diagrams accompanying Mr. Lufkin's paper bring this out very clearly and show particularly the relation between the power actually employed in driving the machines and that wasted in friction. Here is a subject which, though pointed to before, has not yet received the attention to which its importance entitles it. As Mr. Lufkin shows, five-eighths of the average power developed by the motor is employed solely in overcoming the friction of shafting. It, therefore, becomes a question of a very simple calculation to determine the point at which a number of individual motors and lines of shafting can be operated more economically than a single large motor constantly driving the entire shafting. It is not at all improbable that such a calculation might even demonstrate the superior economy of driving each machine by its own motor directly attached. The rate to be charged for motor service is often a puzzling problem for central station managers, who, as a rule, desire to be just to their customers, but are often confronted with the uncertainty of the factors which are clearly brought out in Mr. Lufkin's paper. Of course, local conditions must to some extent modify rates, just as in the case of lighting, but the relations which exist being known, an equitable basis for motor rates may now be said to be within the reach of computability by every station manager.

SOME MUNICIPAL LIGHTING FIGURES.

The paper presented before the National Electric Light Association by Mr. M. J. Francisco, on the fallacy and inaccuracy of the arguments and figures offered in behalf of the municipal ownership of lighting plants, was one of the best the Association has ever listened to. The objection that in one or two respects his data was not quite right or fair, might be allowed to stand, and yet his analysis would be in the main thoroughly true and unassailable. He has the best of the discussion by long odds, and the general circulation of his paper, as proposed by the Association, will do much to inform the public on a subject about which so many absurdities are put forward by the advocates of municipal ownership. We do not suppose that towns and cities will stop buying plants immediately, but we do believe that they will be the more ready and likely to give encouragement to private capital and the development of local enterprises. As a piece of educational work, Mr. Francisco's paper was excellent, and it will bear good fruit.

Magnetic Units.

The resolution passed at a meeting of the American Institute of Electrical Engineers to designate the unit of self-induction as the "henry" has met with general approval in this country, and we are glad to believe also that there is a sentiment abroad in favor of commemorating Henry's name by applying it to a unit. We are strengthened in this belief by the perusal of the letter of Dr. A. J. Fleming, in our last issue, in which he clearly points out again the true position which Henry occupies as a pioneer, and as the discoverer of the phenomena of self-induction. Dr. Fleming, however, seems to lean, and not without reason, to the contracted form, and would prefer to designate the unit by the term "hen." He shows that the contraction adapts itself very well to combination with prefixes and suffixes, the introduction of which would become necessary in the practical application of the unit; but Dr. Fleming goes still further, and, we think, has sounded the keynote of progress in this direction by adding to our existing nomenclature other terms which at the present time are designated by periphrases. That is, he would assign the term "frank," in honor of Franklin, to the unit of magneto-motive force along a magnetic circuit, and he also makes an original suggestion, that the name of the father of electrical science, Gilbert, be assigned to the unit of magnetic induction, one "gilb" being equal to 100,000,000 C. G. S. units of induction, and being defined by the condition that a uniform rate of change of induction in a magnetic circuit of one gilb per second produces an electro moive force of one volt in an electric circuit linked with it. What is, therefore, now termed the induction would thus be expressed by "gilbs" per square centimetre. The criticism has been made in the past that the adoption of so many new terms would be apt to confuse, rather than to simplify, matters; but we believe that Dr. Fleming places the subject in the right light when he points out, as he does by a very simple numerical example, that the adoption of these terms will do away with the necessity of employing Greek letters used for some of them, as well as the Greek letters standing for constant numerics, which always confuse those who would otherwise be able to apply these formula intelligently. We are thoroughly in accord with Dr. Fleming in the adoption of these new terms as practical helps and as commemorative of the names of men great in electrical science.

ELECTRICAL INDUSTRIES AND THE WORLD'S FAIR.[1]

BY JOHN P. BARRETT.

It has been stated by competent authority that had it not been for the exhibition of the speaking telephone at the Centennial Exhibition at Philadelphia the telephone would have been ten years later in receiving popular recognition and becoming a success. It is well known that the individuals who were nearest the telephone invention looked upon it with distrust, considered it a toy and an invention of no great practical importance. But Sir William Thomson, who was in 1876, as he is now, the recognized authority in electrical science, seeing the telephone at the Centennial Exhibition, became enthusiastic over it and endorsed it so warmly that it directed public attention to the invention and made it an immediate success.

Great as are the interests resulting from the telephone which was first publicly exhibited at the Centennial Exhibition at Philadelphia, the importance of this invention extends beyond the particular interests directly concerned. The public attention attracted by the telephone has stimulated activity in electrical industries which warrants the statement that the exhibition of the telephone marked a new era in electrical progress. The telephone and the relation of the Centennial Exhibition to the promotion of its popular success, is mentioned simply as an illustration of the importance of the World's Fair to electrical enterprises. Fourteen years have passed since then, and in three years more the Columbian Exposition in Chicago will be looked for to exhibit the progress which has been made since that date, and to be commensurate with an industry so progressive as to have absorbed an investment of $500,000,000 in the past ten years. It is not unreasonable to say that there will be more interest in the development of electrical science and in the evolution of the art of electricity as applied to various industries, than in any other one branch of the World's Fair. The rivalry in invention has led the United States to outstrip all other nations in the practical application of electricity. Thus it was that the electrical department of the United States Exhibition at the Paris Exposition saved the United States from complete disgrace; and yet the electrical department of the Paris Exposition was the weakest feature of the entire show. Probably the United States in the Columbian Exposition cannot hope to equal Paris in the matter of its general exposition, but in machinery and in electrical matters particularly we should do a great deal better.

The most striking failure of electricity to play its proper part at the Paris Exposition was exemplified by the Eiffel Tower, which was not only not lighted by electricity, but even had its numberless gas jets lighted by hand, after the old-fashioned way. Then the general lighting of the show was not made a feature, but only a very subordinate affair. The only place where electric lighting can be said to have been a feature was in the working of the colored fountains, an English invention and already rather old, but a fine thing and worth repeating at Chicago, with better facilities for spectators. The next most striking lack of the Paris Exposition was in the matter of electric street railways. It would seem that an exposition in these days should have an organized system of electrical locomotion for carrying a lot of passengers quickly and cheaply from side to side and from end to end of the entire grounds. Paris had a steam dummy going around three sides of the ground, but that was insufficient, and the cars were usually crowded just when people wanted to use them. That, however, was on account of the Exposition being such an unexpected and tremendous success. The only means of electrical locomotion used at Paris was an electric crane running from end to end of the machinery building, very slowly, to give people a chance to see the various exhibits from above, and incidentally some rest and some air.

There was also no organized telephone exchange system at Paris. Considering that the Melbourne Exhibition of 1880 had a telephone exchange in full operation inside the grounds, doing substantial service to exhibitors, as well as to the officers of the Exhibition itself, Paris is to be pronounced behindhand in this respect. There was something done in the American section at Paris, for the offices of that section and for some exhibitors, but it was not very well done, and was on a very small scale. There may have been other similar telephone exchanges at work, but there was no good general system for everybody and in connection with the city.

It is the intention in the following paper to point out some lines in which the exhibition of that branch of industry, in which we are all interested, should be protected and promoted according to the brief consideration which the writer of this paper has been enabled to give the subject.

In the first place, electricity will find numerous applications in the way of actual service in carrying out the plan of the Exposition. By this I refer to the fire alarm protection signaling apparatus, electric lighting, both arc and incandescent, transmission of power, telephoning and telegraphing. The location of the Main Exposition having been rightfully settled in favor of the Lake Front, which is practically in the heart of the city of Chicago, and within five squares of the telephone central office, the fire alarm central office and the Western Union and Postal Telegraph offices, it will be a matter of no serious difficulty to make such connections with the general city electrical service as will give the Exposition the benefit not only of its own special outfit in each of these directions, but also the advantage of its outside connections. Aside from this application of electricity to the utility and necessities of the Exposition, the features in which we are all particularly interested are those which illustrate the progress that has been made in the science and in the art. The success that has attended recent electrical exhibitions, such as the one in Philadelphia in 1884, and the one in the American Institute Fair in New York, give us some idea of what can be accomplished in this direction with the immense multiplied facilities at the World's Fair in Chicago, and with the incentive to manufacturers and inventors which comes from having the attention of the whole world directed to their work.

With reference to telephones, as is generally known, the fundamental patent on the telephone will expire in 1893, and we may expect not only the inventions, accumulated and hoarded by the American Bell Telephone Company for the years that they have had control of the business, to be exhibited at the World's Fair, but also numerous other inventions which will be stimulated by the opening of the field to competition. Thus this feature should be given a much greater consideration, and more attention should be paid to it than in any other previous exhibition. We have seen only the beginning of the growth of the telephone business. This is shown by the fact that in the city of Berlin there are now 18,500 subscribers, and the exchange there is growing at the rate of 3,500 per year. I predict that in the city of Chicago inside of ten years there will be 30,000 telephones in use. Such a great increase in the use of telephones calls for apparatus and appliances, the invention of which will tax the best talent of the country for years to come. Of course, in addition to the historical exhibition, and the exhibition of recent inventions in telephones and apparatus applied to telephony, there will be immense numbers of telephones used in and about the buildings of the Exposition.

The matter of telegraphy also should receive its due share of attention. The different forms of quadruplex, the use of dynamos for furnishing the current instead of batteries, and other inventions in which the recent history of the telegraph is prolific, should each and all be suitably presented. Police and fire alarm apparatus of the latest design and the best manufacture, together with all appurtenances, will attract a large share of attention.

The telautograph, which by 1893 will undoubtedly be a practical success, even if it shall not have ceased to be a novelty, will also come in for purposes of exhibition as well as for extensive practical use.

Motors for driving machinery, furnishing power for various purposes, running street cars, etc., will perhaps be even of more practical benefit than any other application of electricity; while electric lighting apparatus of various kinds will take the lead undoubtedly, as it now does, over all other electrical industries.

It is proposed to connect the two parts of the World's Fair, one situated on the Lake front and the other at Jackson Park, by means of a railroad built out on the lake. The expediency of adopting electricity for motive power on this railroad is at once obvious. Thus the two features of usefulness and exhibition can be readily combined, and in addition to the direct transmission of power, storage batteries could be employed for traction purposes on this road.

It is difficult in enumerating the different departments of electrical enterprise to foresee all of them, and particularly to foretell the relative importance of the different ones three years from the present time. In no field of human activity is invention so active and enterprise so energetic, and when we speak of the different forms of application of this science which are well known at the present day, we all know that we are simply on the threshold of future developments which may be confidently expected. At no time in the history of the world has there been so great activity in any given direction as there now is in the department which we represent, and too much cannot be said with reference to the importance of having adequate facilities in the coming World's Fair to display the various industrial and artistic applications of electricity.

What will be exhibited at the World's Fair will undoubtedly be a revelation to the visitors. It should be the aim of the people having the exhibition in charge, to so organize and classify the exhibits as to present clearly and forcibly the progress of the art and the present state of the art in its various departments. A chaotic exhibition of the products of the different manufacturers would accomplish something in the way of creating astonishment and mystifying the beholder. This is not what is desired. It is desired that the World's Fair, as a whole, and the electrical exhibition, as perhaps the most important industrial feature of the exhibition, be made an education. It is not too early now to lay plans for the proper presentment of electrical industries for this great Exhibition of 1893. The combined intelligence of the men who are to-day pushing forward electrical enterprises, working

1. Read before the National Electric Light Association, Cape May, August 19, 1890.

in harmony, will be able to accomplish great results, results which will surprise all of us. But the element of time must enter into all calculations; especially is this the case with a subject so large and so involved as the suitable presentation to the public of the rapidly growing electrical enterprises in their various fields.

The Exposition should be made just what its name implies, a practical exposition of the progress and advances made in the several branches of the science of electricity, and the exhibits should be so arranged that the various improvements may be seen and be appreciated at a glance. Thus will the real object of the Exposition be accomplished and a saving of much valuable time to the visitor be effected. For it is quite probable that fully 50 per cent. of the visitors to the electrical section will go there with the earnest desire to become thoroughly familiar by practical observation and study with all that has been done in some certain industry, either to aid in carrying on a certain line of study or with a view to select what they may there conclude is the apparatus best adapted to their needs. In either case, time will be an important and valuable factor, and how to enable each visitor to quickly and understandingly grasp the more important details and points of superiority of any exhibit should be the main object of the respective exhibitors.

The usual method followed in the small expositions has been to allot a certain space to each exhibitor and allow him to place therein whatever he may desire to bring to the notice of the visitor. This is a good plan, and one which proves economical in many ways to the exhibitor. Another plan would be to allot space for the various types of apparatus, irrespective of the main display of the exhibitor. That is, to place all telephone apparatus and everything thereto pertaining in close proximity; the same with telegraphic apparatus, arc lighting dynamos, incandescent machines, motors, etc. The carrying out of such a plan will, of course, give two or more separate exhibits to each manufacturer, and thus entail some slight additional expense, both in the matter of suitable furniture, and possibly in the matter of attendance; but all this additional outlay would be more than returned in the excellent results attained, and in the simplifying of the study of any particular type of apparatus, to say nothing of the greater publicity given each exhibit. Of course there will be no objection to an exhibitor reproducing a complete display of all his wares in the space allotted to him for his headquarters, irrespective of the fact that many articles may also be shown in the respective space to which they belong.

As far as possible a complete specimen of every article and every size should be placed on exhibition. For instance, in the line of motors, there should be one of each size, from the smallest to the largest turned out; and so with dynamos, batteries, etc. In the space alloted to the display of testing instruments the show-cases should be placed on a flooring above a foundation made sufficiently solid to prevent oscillation of the needle, or injury to the more delicate parts from vibration or other similar cause. Every article should have a neatly printed card attached, of size uniform in proportion to the character of the object displayed, containing the name of the article, the manufacturer's address, and a brief description of its intended use, the same appearing in English, French, German and Spanish.

At the present time there are about 430 separate companies or individuals whom we can expect to apply for space, many of whom will have but a single article or two to exhibit. But every one of this number will probably defer action until the last possible moment, unless the importance of securing the necessary space and having his exhibit in readiness within the appointed time, is impressed upon him. Some of the manufacturers will have to be coaxed into making exhibits, while others will hesitate on account of the expense entailed. The chief or his secretary must attend to all of this, and must spare no pains to secure not only an exhibit, but the *best exhibit* possible for each manufacturer to make.

Great assistance in carrying out a comprehensive and systematic plan for the Exposition may be looked for in the United States Census, the report of the Electrical Department of which is looked for with great interest.

THE NATIONAL ELECTRIC CONSTRUCTION CO.

The National Electric Construction Company, incorporated under the laws of Maine, have recently opened their offices at 620 Atlantic avenue, Boston, Mass. The capital stock of the company is two million dollars. The following named gentlemen are the officers of the company: General Ben. F. Butler, President; A. H. Sawtell, Vice President and General Manager; Hon. Lynus N. Child, Treasurer; T. Henry Pearse, Dr. Allan V. Garratt, General Manager of the Electrical and Engineering Departments. Mr. F. Z. Maguire, of 18 Wall street, New York, is the financial agent, and is handling the securities of the company. Dr. Garratt, of the technical department, is very well known in electrical circles as a young engineer of unusual ability and experience. He has also gained a wide acquaintance in the discharge of the onerous duties of secretary of the National Electric Light Association. Whatever work he undertakes is done with intelligence and conscientious thoroughness, and it is believed that a bright future awaits him in this new field. He will not want friends to help him realise his hopes.

THE DANGERS OF ELECTRICITY.[1]

BY PROF. HENRY MORTON.

WHEN the development of electric currents, on a large scale and at a small cost, first became possible by reason of the discoveries of Faraday, Wilde, Gramme, Siemens and others, the question of the dangers to life and property attending their use was brought prominently before the public, just as the dangers attending the use of steam, of rapid locomotion on railroads, and of dynamite were brought to the attention of the world when these powerful agencies first left the experimental laboratory of the chemist or engineer to take their part in the ordinary labor and business of life.

In each instance alike there was a class of people who took the narrow and partial view, that if an agency was dangerous it should be excluded altogether from public use, or, what amounted to the same thing, be surrounded with such exclusions and limitations as would rob it of nearly all its capacity for usefulness, and restrict all possibility of advance and development in its application.

Thus laws were actually passed in England on the first introduction of steam, limiting the pressure in boilers to 30 lbs. on the square inch.

The first railroad charter contained a clause limiting the speed of trains to 12 miles an hour, and when a speed of 30 miles was suggested, it was ridiculed in a prominent journal of the day as an idea simply insane, and it was said that people would just as soon be persuaded to allow themselves to be fired out of cannon as to be hurled along at such fearful velocities, which would, without doubt, have the most disastrous effects upon the circulation of the blood and other vital actions.

Some of us can also recollect the excitement produced and echoed in the press on the introduction of dynamite, and the stringent laws regarding its transportation, which in many cases only increased the danger to the public by occasioning its surreptitious conveyance in passenger and ordinary baggage cars.

We shall have to be very young indeed not to remember the great popular excitement brought about by the daily press when electric lighting first appeared in the streets of New York, and when flashes of flame were described as proceeding from a horse that had run against an electric wire.

In all the older instances matters have settled themselves in accordance with the laws of human progress and the diffusion of intelligence, and we now have boilers running at pressures of 140 pounds and upwards, trains going more than a mile a minute, and gunpowder largely superseded by dynamite.

What is more, the accidents and injuries actually produced by these several agencies have been vastly less than those caused by the things which they replaced.

A much smaller number of people are killed or injured by high pressure boilers than by low pressure ones. How rarely do we hear of the explosion of locomotive boilers, which usually carry 140 pounds pressure.

The accidents to express trains are as nothing compared to those occurring with freight trains, and the loss of life and injury to passengers by rail is insignificant in its percentage to the number carried, when compared to similar loss and injury incurred in the days of stage coaches.

The same relation has been found between dynamite and gunpowder, the former having largely reduced the proportion of accidents and injuries as compared with the work done.

Two lessons are very plainly taught by the facts of history above alluded to.

First: The world is not going to be frightened away from a new and valuable source of power by the circumstance inseparable from the very nature of all powerful agencies, that it is dangerous if not adequately controlled; but, on the contrary, will develop the new power to an ever-increasing and, therefore, more (possibly) dangerous intensity.

Second: Intelligently managed and controlled, the most powerful and, therefore, in a sense, dangerous agencies, become the most efficient protectors and servants of man, and not only aid him in his mission of subduing and utilizing nature, but actually protect him in his work.

Without these "dangerous" agencies man would be reduced to the lowest condition of savagery, where he would be at all times helplessly at the mercy of the "elements," or the blind forces of nature.

With them he not only defies and subdues the beasts which would otherwise be his superiors, but even conquers and renders tributary to his comfort and advancement those vast forces which control the entire matter of the universe.

Applying these lessons taught by the past history of the world in parallel cases to the problem of the distribution and use of electricity, we see in the first place that the way to deal with its dangers ought not to be the timid, obsolete way of prohibition, or of unintelligent restriction, such as that which proposed the exclusion of locomotives from railroads, or the limiting of their speed to 12 miles an hour, but the sensible way of providing ade-

1. A paper read before the National Electric Light Association, Cape May August 20, 1890.

quate safeguards to the new power, and with these allowing it to follow its natural line of development and growth into higher and higher ranges of intensity and consequent efficiency.

It is too well known to all to need statement, that the methods thus pointed out by history and taught by experience have not been by any means universally advocated or followed, and that while many have loudly demanded the exclusion of powerful electric currents, the limitation of their intensity to what they suppose to be necessarily harmless ranges, the users of such electric currents have in too many cases neglected the most obvious precautions.

It is only fair to say, in explanation of this latter statement, that this neglect has in many cases been brought about by obstructions thrown in the way of good work by those who were exciting themselves for the total abolition of dangerous currents, and who, like certain "total abstinence" advocates, objected to every mitigation of the evil they attacked, because any such improvement weakened their case against it.

As regards dangers to property from fires, the matter fortunately fell at an early period into the hands of the Board of Fire Underwriters, who, in a judicious and business-like way, investigated the subject and formulated such rules as have proved eminently satisfactory, and have proved that under proper regulations as to good work and means of protection, electricity is by far the safest means known to us for the distributing and development of light, so far as "fire risks" are concerned.

In view of the satisfactory results thus obtained, I regard it as a fortunate circumstance that the other part of the problem, namely, that relating to dangers to human life, has been recently taken in hand by a similar organization known as the "Employer's Liability Assurance Corporation."

This association, after collecting a mass of material from a great variety of sources, has some time since formulated a series of rules for the protection of those employed in erecting and operating electric apparatus involving the use of powerful, and, therefore, dangerous currents. These rules have been examined and approved by several of the managers of prominent electric companies, and so far it would appear as if no accidents have resulted from the use of electric currents where these rules have been followed, and that most if not all the accidents which have occurred would have been prevented had these rules been followed and obeyed.

Having had something to do with the framing of these rules, it is my chief object in presenting the present paper to secure their criticism by those best able to perceive their imperfections, and such suggestions as may lead to their beneficial modification or extension.

I therefore quote them as follows:

First. Do not touch or handle any electric wire or apparatus of any sort while standing on the ground, or while in contact with any iron work, gas or water pipe, or stone or brick work, unless your hands are covered with rubber gloves, and you are provided with such properly insulated tools as have been declared to be safe and in good order by the electrician or other competent officer of this company.

If it is at any time necessary to stand on the ground, or on any surface not insulated from the ground, while handling electric wires and apparatus, rubber boots or an insulated stool should be used.

In moving wires, hanging on, or lying over, electric light wires, lamps or fixtures, use a dry hand line.

Second. Never handle any electric wire or apparatus with both hands at once when this can be avoided, and, if it is necessary to do so, be sure that no current is present, or that one or both hands are protected by rubber gloves or other efficient insulation.

Third. When handling line wires, treat each and every wire as if it carried a dangerous current, and under no circumstances allow yourself to make contact between two or more wires at the same time.

Fourth. Never open a circuit which has been in use without giving notice to the superintendent, or whoever is in charge, of your intention to do so, and at the same time request that the same line be opened at the main station, and kept open until you have given notice that your work on that line is complete.

Fifth. In the dynamo room never go near the belts or dynamos, nor touch any apparatus unless you are fully informed and instructed how to do so.

Tools used by linemen should be provided with insulating handles of hard rubber or other equally good insulator. It is the duty of each lineman to look after his own tools and see that they are in good order, especially as to their insulation.

Sixth. Lamp trimmers and others engaged in the care of lamps must see that the switch putting the lamp in circuit is turned off before they handle the lamp in any way.

Seventh. In construction work, a space of at least 20 inches must be left between the holes for pins on the cross arms, so that a lineman may get to the top of the pole and work without danger.

The same insurance association has collected the authentic records of a number of so-called "electric accidents" or accidents happening to the employés of electric companies. I have now before me the abstracts of 91 such cases.

The first thing that presents itself in looking over this set of abstracts is that very few of the accidents are in any way attributed to electricity directly, but would have occurred had the establishment in question been any kind of a factory where power was being used, or any place where heavy objects were being moved. A few examples will illustrate this, thus:

"No. 1. Whilst steadying with a pike-pole a large electric light pole which was being placed in position, a passing 'low-gear' belonging to the Standard Oil Company ran over ankle."

"No. 2. While assisting in hoisting a stick of lumber from the street to the second floor of electric station, was injured in right foot by having the stick fall upon it."

"No. 9. Was going to dynamo, stepped on iron plate temporarily covering a belt hole in floor. The plate tipped and he fell partly through the opening, injuring himself internally."

"No. 17. Was oiling rocker shaft of engine near fly-wheel; leaned back too far and was struck on head by spider of fly-wheel."

The above are fair samples of the rest, and, in fact, out of the 91 cases but 15 (or about 16½ per cent.) have any direct relation to electricity.

As I have already mentioned, of the 15 cases in which the injury was in any way caused by electricity there are none in which the action would not have been avoided if the above quoted rules had been observed. Thus, beginning with first in order as arranged in the abstracts, all before it having no direct connection with electricity, we have:

"No. 11. While removing the wire from a Brush dial or regulator which had become short-circuited, was slightly burned on two fingers of right hand."

In this case the beneficial effect of rule No. 2 was manifestly expressed, and had the spirit of rule 7 been complied with even the slight injury experienced would have been avoided.

The next in order is:

"No. 20. Was putting carbon in electric lamp which was out of order and failed to burn. Received charge of electricity, which caused him to fall down from step-ladder on to steam radiator. Two ribs broken."

This would clearly have been avoided by an observance of rule 7.

Time will not permit me to quote all the 15 cases, and I will, therefore, only repeat that they would, all of them, have been avoided by a strict observance in form and spirit of the above quoted seven rules or directions.

Of course I do not mean to imply by this that these rules are perfect or complete, but only that they seem to be in the right direction, and to furnish a starting point from which further developments may proceed.

No one having even an elementary knowledge of electricity as it existed 10 years ago, needed or needs to be convinced of its power to do harm where all safeguards are removed, and the occasional declarations of its harmless character which have been uttered can only be accounted for by reference to that combatitive disposition which impels some minds always to take a view in opposition to any which may be expressed, and gives birth now and then to a book or pamphlet disproving the law of gravitation or the solar origin of light and heat. To say this is, however, far from agreeing with the other extremists who would banish electricity from our daily walks and occupations, or place it under restrictions which *might* render it harmless, but which *certainly would* render it relatively useless for the countless purposes in which its efficiency demands its full development.

The true opinion is that which is supported by past experience, and which advocates the fullest developments of power to which this agency can attain, combined with the use of all the means of protection by which human intelligence can protect itself while using to the utmost this potent and, therefore, dangerous weapon in our victorious contest with the inimically destructive forces of nature.

THE OLD-TIMERS' MEETING AND THE TELEPHONE CONVENTION.

The time of holding the annual convention of the Old-Time Telegraphers and the United States Military Telegraph Corps has been postponed from Sept. 10–12 to Sept. 15–17, so that there would be no conflict with the convention of the National Telephone Exchange Association, to be held in Detroit at that time.

EDISON GENERAL ELECTRIC COMPANY.

Mr. J. H. Vail has been appointed Assistant Engineer-in-Chief of the Edison General Electric Co., and has entered upon his duties. It will be remembered that Mr. Vail was the chief engineer of the old Edison Electric Light Co., and his fitness for the new position will be immediately recognized. The appointment gives no small pleasure to his host of friends.

DEATHS FROM LIGHTNING.

Prof. Bidwell, writing in *Nature* of lightning, quotes figures showing that in England and Wales, from 1852 to 1880, the average annual death rate from lightning was considerably below one per million of the population.

MUNICIPAL LIGHTING.[1]

BY M. J. FRANCISCO.

THE electric spark that Franklin gathered upon his key lay dormant for years, until from the fires of genius, guided by the finger of science, there flashed forth the electric light. This has been increased and magnified, until to-day America stands as the exponent of this science, with 300,000 arc and 4,000,000 incandescent lamps flashing like meteors across the continent. Thus has science aided nature in lighting up the streets and highways of our native land, from the shores of the Atlantic, across the snowy peaks of the Rocky Mountains, to the golden shores of the Pacific.

This vast industry, requiring an army of over 300,000 men and an investment of $300,000,000, is the result of American genius and enterprise. Truly we may well congratulate ourselves that we are here to-day as the representatives of this science and industry, which is revolutionizing the world. Not only has the globe been encircled with telegraph symbols and the human voice sent flying across space for thousands of miles, but the ocean itself has been studded with electric lights, guiding the mariner across its waste of waters and flashing its brilliant hues as a welcome beacon upon the weary eyes of many a watching crew, whose vessel was sinking in mid-ocean.

This science, fraught with so much good for mankind, which has put millions of money into circulation and furnished employment to thousands of laboring men and others, is now menaced by men who, posing as economists, desire to use this power for political and other purposes, as well as for their own aggrandizement, regardless of the interest of the masses or the public welfare. The plain English of this movement is municipal control of electric lighting plants.

Who are the great apostles of municipal ownership of electric lighting plants, claiming that municipalities can furnish lights cheaper than private corporations? Mostly visionary, theoretical dreamers. Not one has had a single day's practical experience in the electric lighting business. For example, we were treated to a specious article in the New York *Independent*, purporting to come from a professor of Johns Hopkins University. An examination of the article shows at once that the author has no experience or practical knowledge of the business, and proves to be simply a youth from Omaha, Neb., who has been studying there for a couple of years. He is now told to cry monopoly, and this article is the result. These are the persons who are being used by professed economists, wire-pullers and others as figure heads; who make statements based upon a state of things that do not exist, and use such statements in contradiction of the actual experience of practical men and the best scientists of this generation, who have not only made the subject a study, but demonstrated the same by testing it every night for years.

If a municipality can sell electricity cheaper than private corporations, why should they not manage all other industries and trades of the country? All cities have large amounts of printing done; why not have the city own and run paper mills and printing offices? also street cars, and own mines and sell coal? They also use immense quantities of stone, building material, etc.; then have them run a marble quarry. The tax payers use carriages; let the city build these also. And so on with every industry requiring the investment of private capital. If municipalities can save the tax payer money in controlling and manipulating one industry, why not all? If they can do it cheaper, then every tax payer would receive the same proportional benefit as is claimed for electric lights.

The great argument used in support of municipal control of lighting plants is a list of cities, with what purports to be accounts of the cost of their electric lights, where over half of the expense of the lights has been charged to other departments. Among these are Bay City, Bangor, Dunkirk, Chicago, Ypsilanti, Topeka and Lewiston.

We will examine a few of the claims made as to the cost of lights in these cities.

The City Superintendent of Bay City, Mich., reported that the cost of the electric lights was only $40 per year. The Council of Bay City appointed a special committee to investigate the expense of city lights, and they submitted a report showing that the city was running 137 lights at a cost of $59.42 each per year, not including taxes, water rates, interest or depreciation. Including interest, 5 per cent. on $35,000, cost of plant, taxes and water rates, 2½ per cent., 10 per cent. depreciation, the cost was $104 per year each lamp, running only dark nights. A short time since, during a thunder shower, the city was left in darkness, because the City Superintendent was afraid of burning out an armature if he ran the lights. A gentleman passing an evening in Bay City recently inquired why they did not have street lights, and the answer was "We do have them," and sure enough, at 9 o'clock they started the lights. Still the price charged by electric light companies for first-class service, with lights every night, even when obliged to compete with the rival forces of Heaven's batteries, is compared with such service as shown in Bay City.

1. A paper read before the National Electric Light Association, Cape May, August 20, 1890.

The city of Bangor claims that the average cost of burning light each night is 12⅝ cents; that is $46.23 per year for each lamp. The electrician is paid $78.50 per month, or $942 per year his assistant receives $520 per year; one lineman is employed at $624 per year; two trimmers at $1,248 for the year—making $3,331 for wages of these men, being $22.82 per lamp per year. They run all night, requiring double lamps and four carbons for each and every day, calling for 1,460 carbons per year each lamp for these they pay $13 per thousand, and in addition pay 96 cents per thousand for freight and 5 cents per thousand for cartage from the freight-house, making cost of carbons $14 per thousand, or $20.44 per lamp per year. Allowing $2.97 per year for oil and waste, we find the amount paid by the city for wages, carbons, oil and waste was $46.23 per lamp per year. This is 12⅝ cents per lamp per night, just what is claimed as the entire cost to the city for running their lights. The plant cost $35,000, and this does not include anything for the water power nor for any portion of construction of the dam or cost of its maintenance, or for the station buildings. Interest on $35,000 at 6 per cent., $2,100; depreciation on electric apparatus, 10 per cent., $3,500; broken globes during the year, $130; wall controller burned out, costing $160; 15 lamps broken, repairs costing about $300; damage to mast-arms, repairs costing $100; repairs at station, $500; also $730 paid for coal. Here is $7,520, which is part of the expense of the electric lights charged to some other department, while to get the true cost there must be added to this the repairs to the dam, interest on the cost of the buildings, wages of an engineer when engine is used, cost of new brushes and segments; also taxes and water rent, which the city would receive from a private corporation if running the lights, which at the lowest estimate, would be over $1,000 per year; thus making a total cost to the city of $15,271.86 for running 146 lamps one year, being $104.59 per lamp, and that, too, with water power all the time except for about six weeks.

The favorite place quoted by advocates of municipal ownership is Dunkirk, N. Y. I herewith give the report of the water commissioners of Dunkirk. As a specimen of expert bookkeeping, and a sample of the way accounts are kept by cities, I recommend the plan to all electric light men; for, if you are endeavoring to satisfy your constituents or stockholders that electric lights can be run without money and without price, t cannot be excelled. The report reads as follows:—

"PAID ON ACCOUNT OF ELECTRIC LIGHT.

For linemen's salary	$ 540 00
For fuel	933 24
For supplies	447 60
For labor repairing line	41 42
For repairs on engine and boiler	65 64
For repairs on machinery	99 40
For miscellaneous accounts	14 60
	$2,141 90

"The above statement shows very distinctly that the most sanguine predictions as to the cost of running the electric lights of this city have been more than realized. After a trial of one year and 8 months, the machinery and line are in better and more perfect condition than when first started. The cost of our electric light does not exceed 1 cent per hour for each light."

Here we have a report from the city authorities stating that the entire cost to the city of running 55 arc lights one year was $2,141.90.

You will notice one item is repairs on engine and boiler; also one item for fuel, showing that the plant was steam power, and, what is far better, a style of boilers and engine that ran the entire year, starting and stopping at proper times automatically, without anyone to look after them except a man occasionally to make a few repairs—the coal walked into the furnace without assistance, and no one was employed in or about the station, neither did the plant cost the city anything.

Here is a sample of the reports made by politicians and those professed economists, which shows just how reliable they are. Of course, a man of practical experience and knowing that electric lights do not run without human agency, would look further before accepting such a statement, and when we examine the accounts of the water works we find engineers and firemen paid $3,555; supplies, $449; general expenses under superintendent, $995; miscellaneous accounts, $240; superintendent's salary, $720; interest on bonds, $7,025—making $12,984 additional. Even if only one-third of this is charged to electric lights, we have $4,328 to add to the $2,141, making $6,469 for 55 lights, or $117 each per year. Consistency, thou art a jewel!

Chicago, it is claimed, is the centre of the world, and the only place on this mundane sphere where mortals can be happy, and where life can be spent without thought of money or the hereafter, because their electric lights only cost $73 per year. We admit that Chicago has triumphantly secured the World's Fair, and is now transposing our national air to "Hail, Chicago! happy land." But they have not yet seen the bills for the electric lights as furnished by the city and used on that occasion. When they

do, the city electrician will need to add something more to his stereotyped answers that the cost of city lights "does not include any expenses such as you mention—taxes, water rent, interest on investment, insurance, repairs, depreciation or renewal of plant in general;" neither will it be expedient to charge the wages of the electric light linemen to the fire alarm telegraph department, notwithstanding it works very nicely now, and helps wonderfully to make the cost of an arc light appear small.

Upon investigation of one of their stations of 275 to 300 light capacity, I find that the chief engineer receives $1,200; assistant, $1,030; four firemen, $2,880; six trimmers, $3,240; line tester, $720; three linemen, $2,520; cost of carbons, $3,800; fuel, $12,000; interest, $14,000; depreciation, 2½ per cent., $8,750; oil, waste, repairs, globes, taxes, etc., $7,000—making $57,190 a year expense for running 300 arc lamps, being $190.63 per year per lamp, and this makes no provision for salary of electrician, superintendent, or for armatures burned out or any accidents or damages. With the linemen's wages charged to the fire alarm telegraph department, we can reduce this $2,520. Now, to what other department do they charge the other expenses to reduce it to $73 per year per lamp.

Ypsilanti, Mich., is the Mecca toward which all advocates of municipal ownership turn their longing eyes, and we are informed that the entire cost of a 2,000 c. p. lamp is $23.61 per year, when the truth discloses the fact that Ypsilanti pays $72 per year, only running 18 nights a month until midnight. Wishing to have the views of the prominent authorities of this wonderfully managed city, the following questions were propounded, and I give both the questions and answers.

Q. 1—With your experience, are you in favor of cities doing their own lighting? *A.*—No.

Q. 2—Why? *A.*—Political preferences and frequent changes of management are too expensive. Incompetent engineers, linemen and trimmers kept in place by a committee for political or other purposes; poor carbons, lack of attention generally, grounding of wires, breaking of globes, infringement of patents, constant repairs, etc., make this system expensive and an unknown amount till the year expires. *The wear and tear is immense*, all kinds of complaints and no responsible head is the rule. On the contract plan for light you pay for what you get only, and know what to provide for in the estimate for tax levy.

Q. 3—If your city had the work to do over again, do you think they would do the same? *A.* No.

Q. 4—Has the municipal operation of your plant met all expectations and requirements? *A.* No.

Topeka is another place where electric lights furnished by the city are cheaper than sunlight, and the city jubilant over their purchase. I quote from a letter written by a prominent official of the city of Topeka, which seems to prove that their millennium has not yet arrived. He says: "The agreement for all night lighting was $6 per light per month. We find that the cost of operating the plant of 184 lights for all night has been $11 per month. The agreement further provided that lights should be 2,000 candle-power; all the tests we have made does not show them to be over 500 candle-power. Our lights so far have been very unsatisfactory. My own opinion of the matter is that it would be much cheaper in the end for the city to have contracted with some of our electric light companies here to furnish the city with its lights at so much per light. We would then have known at least just what they would have cost. As it is we have to take our medicine, which is liable to be a very expensive dose. It is a very expensive luxury, and there are so many expenses coming up that we cannot foresee; therefore, I say, when you take everything into consideration, interest on the investment, wear and tear on machinery, dynamos, etc. (the contractors are already building over ours, and they have not run two years yet), consider well before contracting for a plant." Here is the opinion of an honest official who has had experience with a city owning a plant.

Lewiston, Maine, is another brilliant example of municipal ownership. They have a plant of 100 arc lights, which cost the city $15,000. They burn, on an average, 24 nights per month on moonlight schedule, and the Mayor says the actual running expenses are $4,200 per year. Add interest on cost of plant, depreciation, 5 per cent., taxes, rent of water power which the city would have received from a private company; therefore it is costing the city for 100 arc lights, using water power, $7,200, or $72 per lamp per year, while the local electric light company offered to furnish the same lights for $5,760, being $1,440 less than it costs the city to run their own lights; and still it has been advertised broadcast that the cost of arc lights in Lewiston was only 14 cents per night.

I have secured reports from fifty municipal plants, embracing nearly all the cities and towns in the United States owning plants, and find that the cost of these has been $1,511,225; that they are using 3,725 lamps; 12 places running all night and 38 until midnight or on the moonlight schedule; that the average price paid for coal is $2.34 per ton; that the actual running expenses have been $251,194; that the interest on the cost of these plants is $90,691; depreciation at 5 per cent., $75,576; cost of replacing armatures actually burned out, $12,000; taxes city would have received from private corporations if they had furnished the lights, $15,715—making the total expense to these 50 cities of burning 3,725 lamps (two-thirds of them only until midnight) for one year $444,486, or an average cost of $119.24 per lamp per year. In the figures going to make up the cost of plants and the running expenses I have taken the statements and amounts as given by the city officials, but when we are told that the total amount paid for a complete plant of 68 arc lamps, with engines, boilers, dynamos, etc., was only $1,300, and informed that the total running expenses of a plant that cost $12,000 are only $1,100, and in the same communication the statement is made that they pay their engineer and linemen $125 per month, making an annual bill for these men's wages of $1,500, we naturally long for the secret which enables them to settle this amount and pay for repairs, oil, coal and other expenses with an expenditure of only $1,100.

I have statistics from 365 electric light companies furnishing 35,100 arc lamps for street lighting, three-fifths burning their lights all night and two-fifths burning until midnight or on the moonlight schedule. The average cost of coal is $2.76 per ton. The average price charged per lamp for street lights is $118 per year. This is the price when furnished by electric light companies, who have assumed all the risks and liabilities incurred in the business, and who must furnish first-class lights. This is the cost with lights burning every night without a break, as the contract calls for, and necessitating a rebate if lights are out, which would reduce the price paid by the city.

Only one-third of the cities owning plants run them all night, while of street lights furnished by private companies three-fifths burn all night. Lamps all night and every night would burn 4,000 hours per lamp, while the moonlight schedule would only require about 2,100 hours per lamp. The cost to companies, of course, is much more for all night lights than it is until midnight, and had lights run by municipal plants been burned the same length of time as lamps furnished by private corporations the average cost would have been still more, as lights must have burned about twice as many hours.

It will be noticed that the average cost of coal used by municipal plants was $2.34 per ton, owing to the fact that the majority were located near the mines or places where coal was cheap, and the average as shown for electric light companies is $2.76 per ton, owing to the fact that coal was transported long distances, at high rates of freight. Even with this factor against them, it shows conclusively that private corporations are furnishing cities with lights for less money than they can themselves produce them while owning the plant. This, too, with the expense of operating city plants figured as given by the various cities, which their own report shows is incorrect, and less than actually paid.

It is well known that if a private corporation is furnishing municipal lights, when they are out for a short time or are not up to standard, a rebate has to be made, amounting in the aggregate to many thousands of dollars; but you will never see this item deducted when advocates of municipal control are quoting the cost of lights. Neither do they allow the fact of the city's liability for damages and accidents to be developed. If the municipality own the plant they assume these chances, and here is a feature of responsibility which in most States rests upon the individual as well as the city. The property of any citizen can be held for an execution against the town for injuries caused by a municipal plant, no matter if it amounts to thousands of dollars, and thus he might be deprived of his most valuable personal rights and liberties. If electric light companies furnish the lights, they must meet such claims and protect the city from loss, and the court records show that electric light companies have paid heavy damages on this account.

In the reports received from city officials regarding the cost and operation of their lights, one says: "No expenses charged to lighting account." Again: "Lights are not started for an hour after dark." Many say: "Whenever a thunderstorm approaches lights are shut down and city left in darkness." Another says: "Have not had lights for past two weeks, owing to some trouble at station;" while many report wages of employés charged to water department, and others that no account of lighting expenses is kept. Here we have the basis upon which reports are made that the cost to cities owning plants is so much less than it is when private corporations furnish them, simply deceiving the taxpayers by charging part of the cost to other departments, while raising a hue-and cry about the extortion of electric light companies.

No sane or fair-minded man will, with the corruption and fraud practised by politicians at the present day, attempt to prove that it is for the best interest of the taxpayer to place faith in the honest or conservative management of any enterprise which can be manipulated in the political arena for the advancement of the men in power. The histories of New York, Philadelphia and many other cities are samples of such methods and their purifying effects upon politics. Hypothesis and theory may do on paper, but actual results obtained by practical application and experience are the only reliable data upon which to base any statement relating to the cost of street lighting. In every case these have shown, where all the facts are given, that it has been for the best interest of the citizens and taxpayers to contract

with an electric light company for lighting the streets of any city.

Many cities have found by actual experience, after spending a large amount of money, that this is a fact. The city of Greenville, S. C., has sold out its municipal electric lighting station, the purchasers agreeing to relieve the city of all pending liabilities in connection with the light plant. The city has agreed to pay $100 per year per lamp for not less than 40; the agreement to run for 15 years. Negotiations are pending in several other cities for a sale of their plants to the local or private electric lighting company, as they have found that it was impossible to produce the light, when managed by politicians with no interest in the business, as cheaply as could be done by a private corporation whose managers were financially interested in its success.

There is another feature of this business that it is well to consider. Under the authority and sanction of the Legislatures of the States, private capital amounting to millions of dollars have been invested in the enterprise of electric lighting. The benefit that municipalities have received from this capital is enormous, and it is a question whether the private capital thus locally invested under the sanction of the State can be jeopardized and endangered by the action of municipalities, who are subject to and under the control of the State. In England this matter is fully settled, and no municipality can operate its own plant, if by so doing it will interfere with any local or private company authorized by Parliament.

Judging the future by the past, with the mighty strides that have been made in electrical inventions, two years from now the entire apparatus at present owned by municipalities may be consigned to the scrap pile, and necessitate a new outfit costing thousands of dollars. What is to be done in this case? Levy another tax or issue more bonds, and thus load the city with more debts. Electric light companies have already had this experience and I can cite a case where the company paid $4,500 for their dynamos, and, after a little over two years, could only realize $300 from those same machines. Why is this? Simply that improved plans and apparatus have been discovered which reduces the cost of producing electricity, and unless companies can control these new patents they will be stranded in the race of invention.

Consider, then, for one moment the effect upon the business world if to-day it were possible to blot out electricity and electric lights, with all their conveniences, comforts and luxuries; to stop the progress and development of this wonderful science, and shroud America in a gloom that could only be expressed by Bryon when he "had a dream which was not all a dream," and

"The bright sun was extinguished,
And morn came and went—and came—and brought no day,
And all hearts were chilled into a selfish prayer for light.
The rivers, lakes and ocean all stood still,
And the clouds perished. Darkness had no need
Of aid from them—she was the Universe."

THE VALUE OF DETAIL IN THE CARE AND LABOR OF ELECTRIC LIGHT STATIONS.[1]

BY A. J. DE CAMP.

It certainly is a fact apparent to any one who has had the handling of electric light stations that it is essentially a business of detail. The larger items about the business are very easily handled. They will take care of themselves if they are put in the right direction; but there is an infinite number of small things which very materially affect the successful operation of an electric light station. As an illustration of what I mean by that term, I will say that after considerable reflection and dividing the items worthy of care and attention in the management of the business under fifty heads, all of which have to be kept track of, and all of which are a positive and a direct item of expense or income, I find five items which I have had to class as miscellaneous expenses. These include all those items of expense which have a bearing on the business in general, not chargeable to any one of the particular heads under which I have seen fit to group the business. I find that the amount involved in miscellaneous items for the last year, in one company, was about $15.000; the space occupied on the books of the company to cover these small items was twice as much as the whole of the other part of the business. The items there reached from one penny up. There is no doubt but that detail may be carried to such an extent that it becomes burdensome. It may become unprofitable on some particular item, but we can only treat this matter as a whole. In one item of carbons alone the reduction in the expense of the carbon caused after a system was adopted by which they were accounted for on the basis of the inches, there was a saving of nearly fifty per cent. in that item alone.

Another important thing is the matter of discipline, because it is utterly impossible to get the detail part of your business thoroughly carried out unless you have a thorough discipline about your station. The most important item in the whole operation of an electric light station in point of dollars and cents is that of labor and I do not see but what it will always be the case. I remember there was a time when we thought that sixty lamps on an ordinary circuit was a day's work for a man. Now they trim a hundred lamps more easily than they used to trim sixty, and my own judgment is that in the course of time we will work up so that 150 will be no harder than 100.

A custom of dealing with labor, I think, which requires the accounting of every minute of time for which a man is employed, has a very beneficial effect. I think that alone can be credited with a reduction in the pay roll of some twenty-five per cent. A custom has been adopted by me of having a slip furnished to the workman by which he accounts for every hour of service; this gives the man who has charge of him an opportunity of judging for himself whether that man has employed his time properly during the ten hours. In the early history of the business it was the custom of my company to do a great deal of work without charge. That was done for policy sake. The number of men apparently required for the operation of the station was very far in excess of what anybody ever represented it to be or supposed it to be. In looking into it we found that there were two or three men working here, and two or three there, and three or four somewhere else. What were they doing? Well, they were making changes, shifting the position of lamps, they were doing this, that and the other thing. Well, we were going to be through with that and let these men go, we thought. But the fact is they never did go, they hung right straight on all the time. We closed that month and started in the next on the basis of charging for all work. The basis of the charge was mainly for the labor, charged at thirty cents an hour, and all waste materials. We did not charge for anything that would be incorporated into our own property.

At that time, I think, we were running about 350 lights, and when at the end of the month we charged that up and it amounted to over $800. We tried to collect it, but I presume we did not collect more than $200 out of the $800. People demurred and would not pay it. But it brought the thing to an understanding. Now, no work is done after the first installation unless it is to be paid for by our customer, and we get an order from our customers in which they order the work to be done and to charge it to their account. That brought the next month's charges down, and all we had occasion to charge them was something less than $200. There could be no better proof in the world than that very fact that as long as people did not have to pay for a thing they were very free to indulge their fancies.

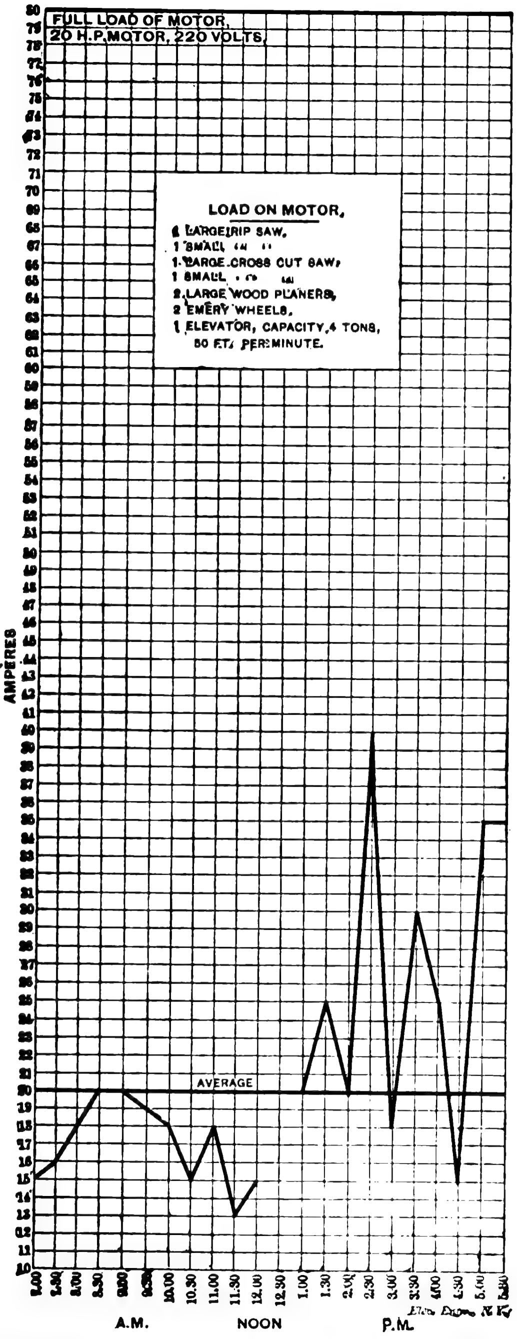
Another point: We send a man out to do a job and he comes in and charges three, four, five, six, or ten hours' time. The man for whom that work is done cannot account for more than an hour or two Then comes your discussion on the payment of that account, and it is a great trouble. We know nothing; we charge a man's time from the time he leaves the station till the time he gets back and reports to us, and whether he has put in that amount of time, less the time of coming and going, of course we have no means of knowing; at least, we did not, but we get nearer to it now. That is one of the things that takes a great deal of time, and I have noticed that our charges for that sort of work are very much more equitable, according to the judgment of our customers, than they have been heretofore; and, moreover, we find that the men do a great deal more work.

Another question which I think can be very profitably discussed is that which relates to small matters of income on your revenue account. The electric lighting business is not in such condition that you can take the ordinary stand and say to the public, "You will take just what we can give you, and just as we want to give it to you, or get nothing." We make our contracts as specific as we can; but we have not got a contract under which we have not given more service than we agreed to give in that contract. The service rendered is never below the standard. We have lights running on the twelve o'clock service plan; and our contracts for that service cover seven hours of maximum burning. That would mean strictly that at no time was the service rendered by those lights to exceed seven hours, which, in the winter months, is from five to twelve. But that does not do, because five o'clock is not early enough in three or four months of the year, when the lamps are sometimes lighted as early as three o'clock. It means rather an average of seven hours than it does a maximum of seven hours. In any city where there is a restriction on the running of wires, it is necessary that you put half night lights on all night circuits with the object and purpose of switching them off, individually perhaps at twelve o'clock. A customer can hardly be relied upon to do that, and the only safe way to do it is to have them switched off by your own employés. It is the same with all night lights which might be run, and sometimes are run. Those conditions must be met. You must give the people what they want, or you will finally lose your business, and you will have to be getting new business all the time.

As long as I have been connected with this Association, and as large an acquaintance as I have among electric light central station men, I never have found any one yet who seemed to have any appreciation or any interest in knowing just exactly what his product cost him on the same basis on which he sold it. To get at the cost of a light, or of any particular part of it, it is very generally figured up as a horse-power. But the point that I have always contended for is this. I rent a light for a given length of

1. Delivered before the N. E. L. A., Cape May, August 20, 1890.

time, for a year, if you choose, which is the most favorable contract that I consider that we can make, because it gives us the longest service. In doing that you figure it on the basis to furnish light 312 nights per year, which you sell at so much per light. Now, you really want to know, not what the 312 lights cost you, and how much you get for them, and take the difference, and let that be profit or loss just as it happens to be, but you want to know just what each one of these lights cost you, and you want to know it as a whole; you do not want to know whether it takes one horse-power or two horse-power, or half a horse-power,

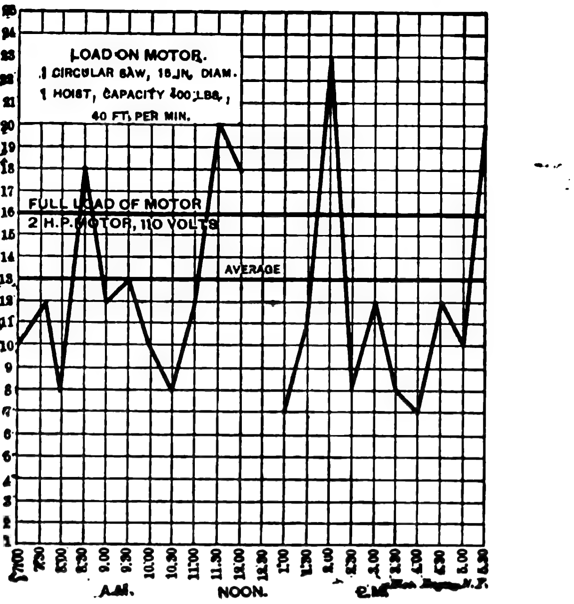


Average Load........................25 per cent. of Rated Capacity.
Maximum Load......................50 per cent. of Rated Capacity.
Average Load........... ....50 per cent. of Maximum Load.
Shafting...............................75 per cent. of Average Load.

No. 1.

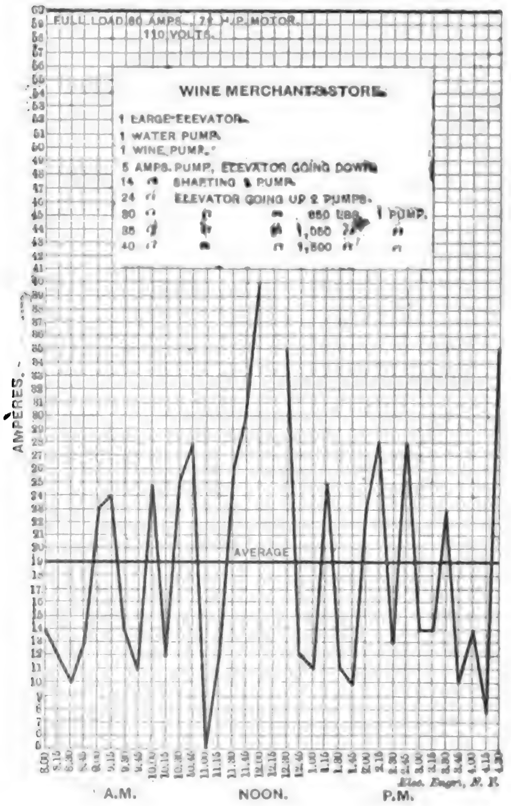
as there are a great many other things besides horse-power that enter into this question.

Another thing that I find to be a very common practice is, to have a uniform price for a light of a certain character, whether the contract is for furnishing light for six months or for a year. The same rate for the longer and the shorter term is unjust to your long contract customers. It is a very easy thing to rent lights during six months of the year, commencing the first of September, October or November, and it is a very easy thing to keep such customers, because they want the lights most at that time. But in the summer time people discontinue the use along about the first of March, April, May or June, and so you have an idle lamp during the summer, in which you have your money invested. I contend that the user of that lamp has no right to expect to get that light at the same price per diem as the man who pays you for a service of 312 nights in the year. But that is



Average Load........................81 per cent. of Rated Capacity.
Maximum Load...................44 per cent. in excess of Rated Capacity.
Average Load........................51 per cent. of Maximum Load.
Shafting.............................55 per cent. of Average Load.

No. 2.



Average Load........................32 per cent. of Rated Capacity.
Maximum Load...... ....67 per cent. of Rated Capacity.
Average Load........................47½ per cent. of Maximum Load.

No. 3.

almost universally done. There is just as much reason for a graduated scale of prices based upon the amount of service you get from your customer as there is for fixing the price for a ten o'clock circuit, a twelve o'clock circuit, or an all-night circuit.

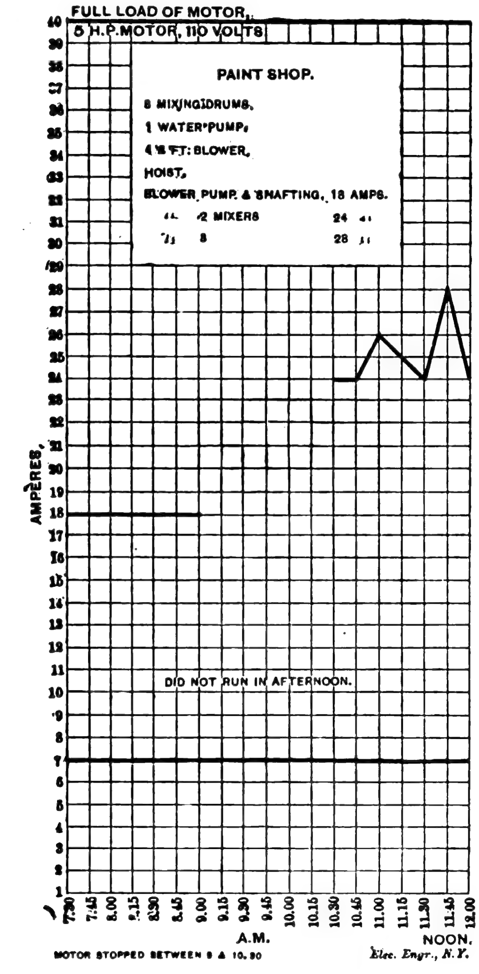
When that first became apparent to me the first effort I made

to equalize the prices on that basis showed me that there was really nothing to go upon excepting guess work. After the first year's experience I had the result of my own experience to go by, by means of which I could work it out in a little better shape. But I found myself doing an injustice to our customers when I thought that I was doing an injustice to myself. I found that I was charging more people too much on that basis and others too little. This puts the company in the position of making a uniform contract in which they can say to every customer, or to every person that comes into the office, that the company will duplicate for him any contract that it has on its books.

A PROPER BASIS FOR DETERMINING ELECTRIC MOTOR RATES.[1]

BY H. L. LUFKIN.

THE equitable adjustment of motor rates, or rather the rates per month, or year, for the supply of current for the operation of electric motors, has long been a matter of considerable annoyance to companies supplying electric power. It is obvious that to invariably charge the motor user an arbitrary rate per horse-power for the motor which he uses, based on its rated capacity, and re-



Average Load......................17½ per cent. of Rated Capacity.
Maximum Load......................70 per cent. of Rated Capacity.
Average Load......................25 per cent. of Maximum Load.
Shafting..........................— per cent. of Average Load.

No. 4.

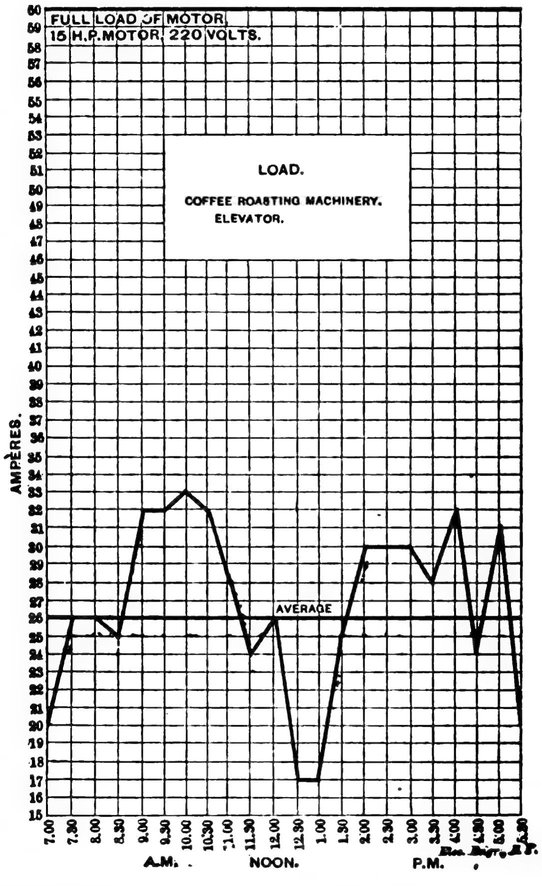
gardless of the work it is doing, is not satisfactory, for the reason that the manufacturer usually prefers to buy a motor somewhat more powerful than his work really requires and thus avoid the possible damage to his motor from overload, or the strain to which any piece of machinery is subjected when constantly operated above its normal working capacity. Again, the manufacturer may contemplate an increase in his plant in the near future, and, in buying a motor, will provide one of sufficient capacity to operate his prospective increase.

To illustrate graphically the practical operations of motors under load, I have taken a large number of records of motors in actual service and from these records have laid out ampere curves or daily load diagrams which will illustrate very clearly the fluctuations in the current supplied to motors in actual practice. Other interesting features of these curves are the maximum, minimum and average readings as related to each other; the current consumed in driving the shafting, as related to the average current consumed; and the peculiarity of the records of motors operating elevators.

Copies of these load records are illustrated in the accompanying diagrams. The vertical lines of these charts, you will notice, represent hours of the day, and the horizontal lines, amperes. In making these records an amperemeter was placed in the circuit in series with the motor and each reading taken was dotted on the chart where the ampere line, corresponding with the reading taken, intersected the hour line corresponding with the time at which the reading was taken. By connecting these dots together with a continuous line we, of course, obtain the diagrams or curves shown.

The highest average use shown in any of these records is in diagram No. 2, with an average use of 81% of the capacity of the motor; this record also shows an overload of 44% at the 2 P. M. reading. Diagram No. 16 shows the lowest average, it being in this case but 24% of the capacity of the motor. A composite average of all these records shows that the average use of an electric motor is but 43.57% of its rated capacity.

It is a fact that many central stations which still use a "max-



Average Load......................43¼ per cent. of Rated Capacity.
Maximum Load......................55 per cent. of Rated Capacity.
Average Load......................78 per cent. of Maximum Load.
Shafting..........................65 per cent. of Average Load.

No. 5.

imum or motor capacity system" of charges have adopted a schedule with the fact in view that where the motor is used for the usual run of intermittent work its average use is much below its capacity. The circumstances of motor use are, however, so varied that a system of rates or charges for power which shall better adapt itself to this wide range of conditions has already been adopted by many central stations, especially those operating constant potential power circuits. This system of charges I will call the "maximum reading system," which is based on the maximum reading of an amperemeter in series with the motor. The station supplying the power reserves the right in its contract with the customer to change or modify the charge for power from time to time as any increase is shown by these readings.

To illustrate more clearly this "maximum reading system" I would refer to diagram No. 23, which is a fair average record. This represents the record of a 15 h. p. motor operating lithograph presses, etc., the maximum reading in this case being 75 amperes, or, approximately, 10 h. p. The user is given a 10 h. p. rate,

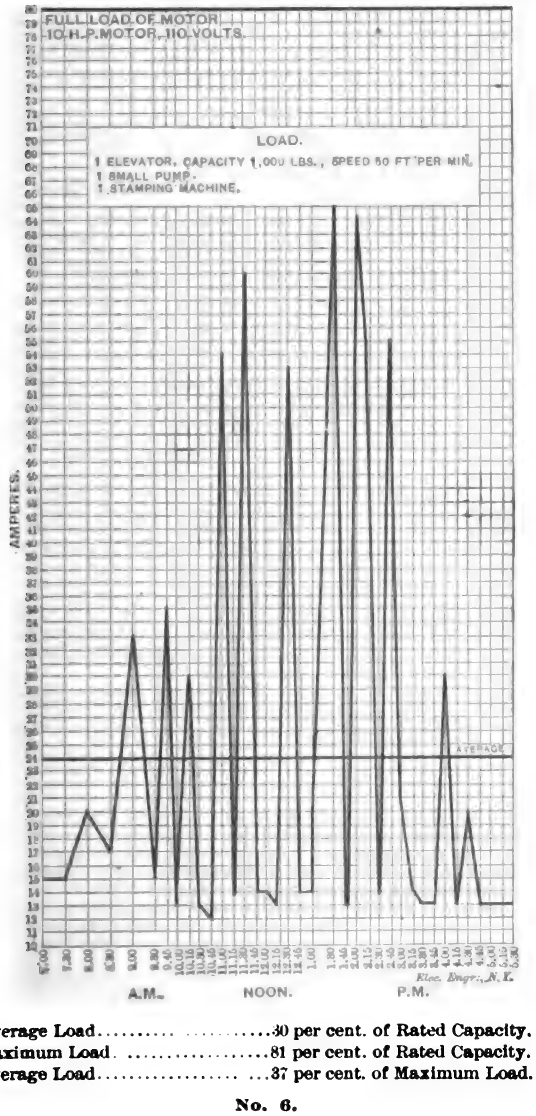
1. A paper read before the National Electric Light Association, Cape May, N. J., August 20, 1890.

which in this case happens to be $60 per month, or a rate of $6 per month per h. p. based on maximum readings. As the average power delivered to this user is but 67% of the maximum reading, the station actually receives at this nominal rate of $6 per h. p. an actual rate of $9 per month per h. p. for the power actually delivered.

The central station supplying this particular motor has adopted the "maximum reading system," and this rate of $6 per month per h. p. is their standard charge for motors showing a reading of 5 h. p. and over up to 15 h. p. From 15 h. p. up their charge is $5 per month per h. p. Their monthly bills are also subject to a discount of 5%, I believe, if paid promptly on the first of each month.

To return again to the diagrams. The records, twenty-nine in number, are of so varied a character that an average taken from all the records, will, I think, show within 1% or 2% of the general average conditions found in electric motor practice. The conditions as shown by these records are as follows:

Average load on motor, 43.57% of its capacity.
Maximum load on motor, 68.24% of its capacity.
Average load on motor, 64% of maximum load.



Average Load.............................30 per cent. of Rated Capacity.
Maximum Load............................81 per cent. of Rated Capacity.
Average Load.............................37 per cent. of Maximum Load.

No. 6.

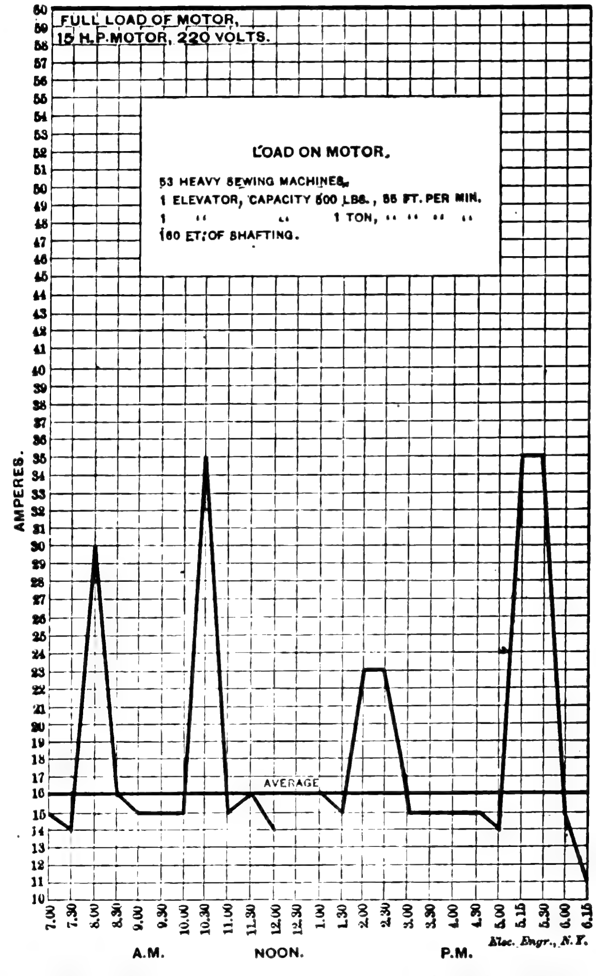
Reducing these averages to dollars and cents we have the following results:

A "maximum capacity" rate of $6 per month per h. p. pays the station $13.80 per month per h. p. for the power actually delivered. A "maximum reading" rate of $6 per month per h. p. pays the station $9.37 per month per h. p. for the power actually delivered.

$13.80 per month per h. p. is certainly a tempting price for power, but it is open to some serious objections. In the first place, at this price the electric motor, even with its much higher efficiency, cannot compete with the gas engine. A good gas engine uses about 20 feet of gas per hour per h. p., or about 5,200 cubic feet per month. Giving gas at $1.50 per thousand (and in many places it is much lower than this), the gas engine will deliver power at a cost of $7.80 per month per h. p. We can, without much trouble, obtain the $9.37 rate per month for a motor in competition with the gas engine, on account of its many and obvious advantages, but we can seldom obtain the $13.80 rate. This maximum capacity rate also very much hampers the user in a selection of a motor, and the motor salesman, in order surely to effect a sale, is very apt to underate the prospective load on the motor, as the customer is governed in his purchase of a machine much more by the monthly charge than by the first cost of the motor.

Another feature which must not be lost sight of is the fact that a motor user who has bought and paid for his machine becomes your permanent customer, his income being entirely derived from the product of the work of his motor. His bills for power you are also sure of collecting, for the moment his power is shut off his earning capacity ceases. The motor becomes to him an absolute necessity instead of a seasonable luxury, as is the case with many electric lights.

Another very remarkable feature brought out by these diagrams is the fact that the average power consumed in doing serviceable work is but three-eighths of the total power used, and the remaining five-eighths (68%) is consumed in driving shafting. This enormous loss in shafting would indicate that the day may not be far distant when each machine will be equipped with its



Average Load.............................26 per cent. of Rated Capacity.
Maximum Load............................58 per cent. of Rated Capacity.
Average Load.............................46 per cent. of Maximum Load.
Shafting.....................................71 per cent. of Average Load.

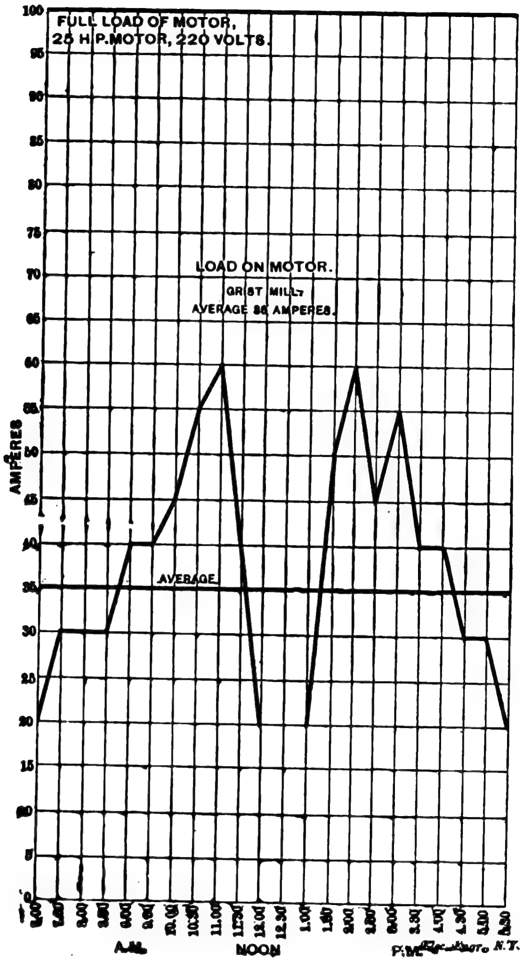
No. 7.

own direct-geared motor and that the days of shafting and belting are numbered.

As a concluding reference to these diagrams, let me call your attention to diagram No. 3, in which a condition presents itself with which you are familiar in theory, but which has, I believe, never before been practically illustrated, namely, the counter E. M.F. in the armature of a shunt wound motor driving a spur gear elevator. When the elevator is coming down with a load the counter E.M.F. runs above the E.M.F. of the supplying circuit, and therefore the motor becomes a producer instead of a consumer, and thus acts as a brake to retard the too rapid descent of the elevator.

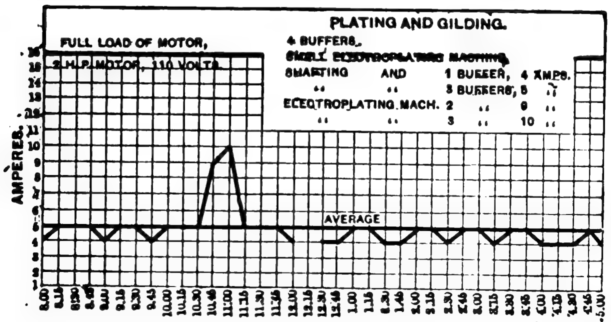
Diagram No. 3 represents the record of a 7½ h. p. motor in a wine merchant's store operating an elevator, a small piston water pump and wine pump. The water pump is in continuous operation, the wine pump and elevator being only used intermittently. The current consumed in the shafting and water pump, which

constitute the continuous load, is 14 amperes. The difference between this 14 amperes and the several readings below that amount, shows the amount of current generated by the motor when the elevator is coming down. As this class of elevator is largely used, this peculiar fact becomes an item of considerable importance to the central station, and is also a strong argument in favor of a constant potential power circuit, as only on this circuit can these conditions be obtained.



Average Load......................35 per cent. of Rated Capacity.
Maximum Load.....................60 per cent. of Rated Capacity.
Average Load......................58 per cent. of Maximum Load.
Shafting...........................58 per cent. of Average Load.

No. 8.



Average Load......................31 per cent. of Rated Capacity.
Maximum Load......................63 per cent. of Rated Capacity.
Average Load......................50 per cent. of Maximum Load.
Shafting..........................80 per cent. of Average Load.

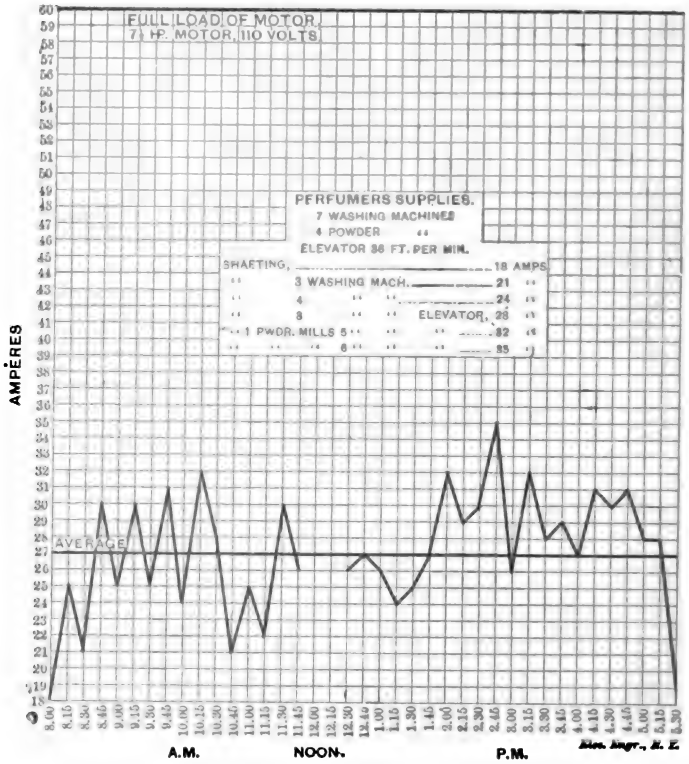
No. 11.

I had hoped to prepare some diagrams of motors on series or arc light circuits for comparison with the records here submitted, and thereby illustrate graphically the advantages of the constant potential circuit for power distribution. Want of time has, however, prevented this.

In conclusion, let me read you some extracts from a letter received in March last from a prominent manufacturing corporation using 75 or 80 h. p. in motors in their work shops:

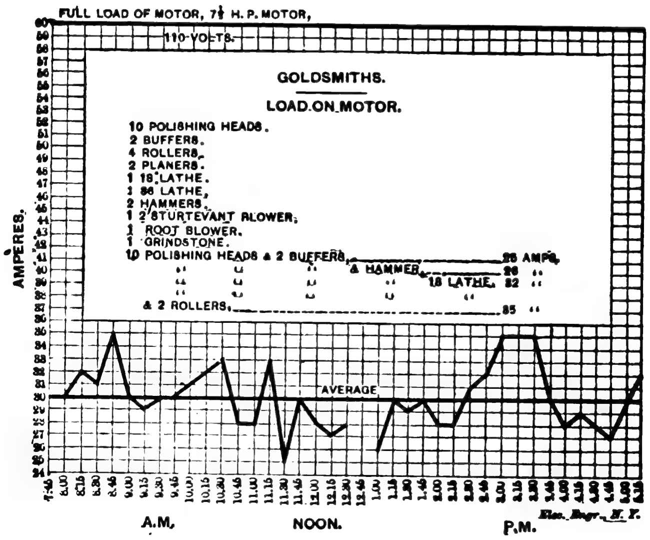
"We are running with one motor a large 4-ton Graves' elevator, and several wood-working machines, such as planers, cross-cut saws, etc. In our machine department, the several motors run several lines of shafting, independent of each other. In this department we run heavy planers, lathes, drill presses, shapers, slotters, gear-cutters and other machinery necessary to a complete machine shop. A motor in our department for fine wood work furnishes power for the various machines necessary to the manufacture of articles needing turning lathes, gig-saws, rip-saws, etc.

"In our experimental department and show room, we use a smaller motor, set with the necessary speed reducing pulleys and belts upon a movable frame. This we roll from place to place as convenience dictates. All of these motors are giving us unquali-



Average Load......................45 per cent. of Rated Capacity.
Maximum Load.....................58 per cent. of Rated Capacity.
Average Load.....................77 per cent. of Maximum Load.
Shafting.........................66 per cent. of Average Load.

No. 9.



Average Load......................50 per cent. of Rated Capacity.
Maximum Load......................58 per cent. of Rated Capacity.
Average Load......................76 per cent. of Maximum Load.

No. 10.

fied satisfaction, and we would not willingly return to direct steam engine power."

This company is being supplied with power by the local electric light company, on a basis of $50 per year per h. p. based on maximum readings. The user is apparently delighted with his service and perfectly satisfied with the cost of his power, and I have the assurance of the electric light company supplying the power, that they would be glad to load their plant under the same terms given this customer.

STANDARDS OF ECONOMY IN THE GENERATION OF POWER.[1]

BY H. M. SWETLAND.

In suggesting to our secretary the subject for this paper as one which would be of vital interest to the members of this Association, I had no idea that I should be called upon to prepare and present it, nor do I feel the fitness of my being chosen to instruct the gentlemen of the convention, whose knowledge upon these matters is the epitome of the best and highest accomplishment of the times.

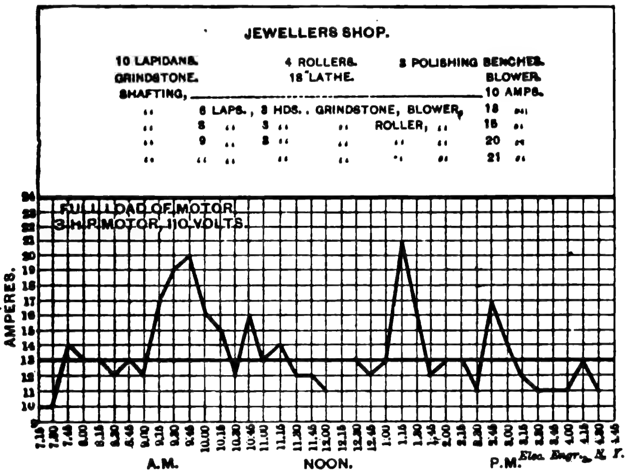
The above title scarcely represents my treatment of the subject. I should prefer rather to call it "A plea for the collection and record of data for standards of economy." In old and long-established lines of work such would naturally be unnecessary. In the electric light business where so much is new, and development is so constant and rapid, it is essential that there should be established some authentic form of comparison of operations with the view of reaching the greatest economy in the shortest possible space of time. Further, in view of the rapidly changing conditions under which the generation of steam power is being operated, the concentration of small and individual plants into larger centres, etc., it becomes of the utmost importance that a careful and detailed system of standards shall be inaugurated and maintained.

Although far more able representatives than myself have heretofore approached this topic, there has been in the convention a noticeable lack of definite, reliable, incontrovertible information in this special direction.

The subject of economy in general has received the attention of our best thought, but it has been directed to the operations of the complete system, and too often details of definite expense are overlooked by the superintendent, whose imperative duty is the running of the plant, not its most economical methods. He is obliged to keep a station in smooth running order to furnish good steady reliable lights, under pressure of constant demand, in which case economy is not the first consideration.

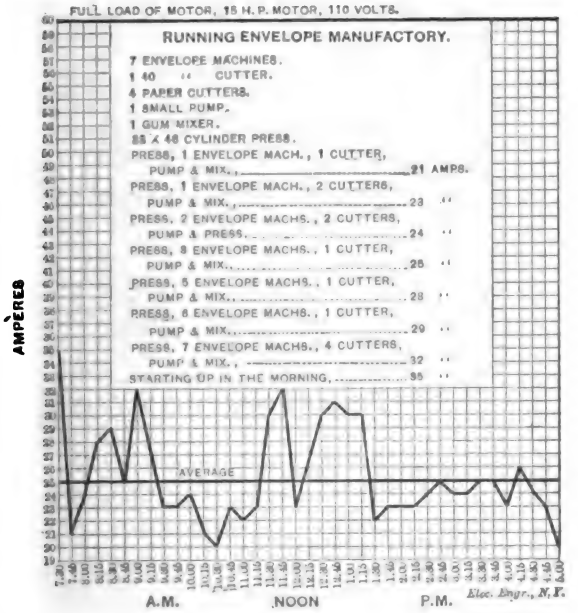
At the last convention the admirable paper read by Mr. T. Carpenter Smith, of Philadelphia, entitled "A System of Central Station Accounts," touched upon and almost comprehended this necessity, but he still further included the maintenance of outside equipment, whereas my paper is confined to the question of first cost of production of power expressed in pounds of fuel per developed h. p. per hour.

The material for the data in furnishing standards of economy should naturally be the practical results of actual operations compiled in tables from the results obtained by different managers. To what end? They would interest and benefit all desirous of investing in electric light and power enterprises which are becoming such an attractive feature in the financial world. They would be useful to prevent the establishment of unnecessary and injurious



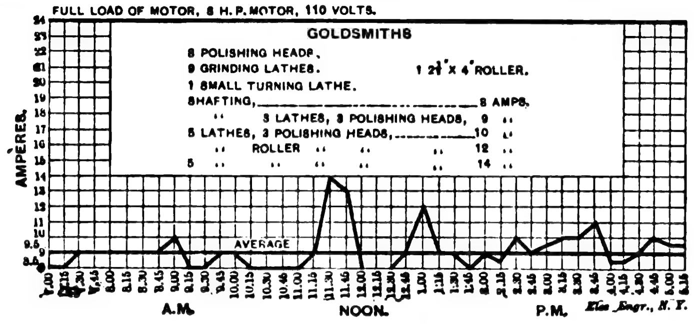
Average Load......................54 per cent. of Rated Capacity.
Maximum Load ....87½ per cent. of Rated Capacity.
Average Load......................62 per cent. of Maximum Load.
Shafting..........................78 per cent. of Average Load.

No. 12.



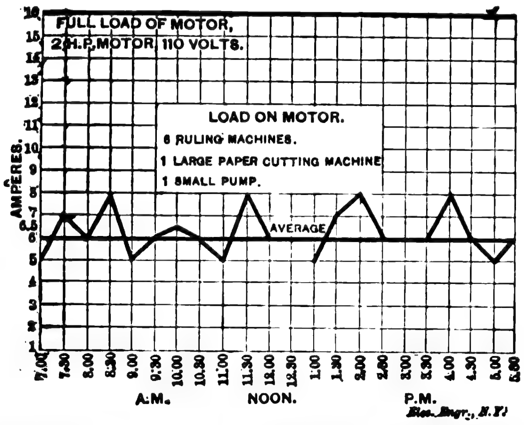
Average Load......................41½ per cent. of Rated Capacity.
Maximum Load.......................58 per cent. of Rated Capacity.
Average Load.......................71½ per cent. of Maximum Load.
Shafting...........................80 per cent. of Average Load.

No. 14.



Average Load......................37½ per cent. of Rated Capacity.
Maximum Load......................59 per cent. of Rated Capacity.
Average Load......................64 per cent. of Maximum Load.
Shafting..........................89 per cent. of Average Load.

No. 13.



Average Load......................39 per cent. of Rated Capacity.
Maximum Load......................50 per cent. of Rated Capacity.
Average Load......................75 per cent. of Maximum Load.
Shafting..........................85 per cent. of Average Load.

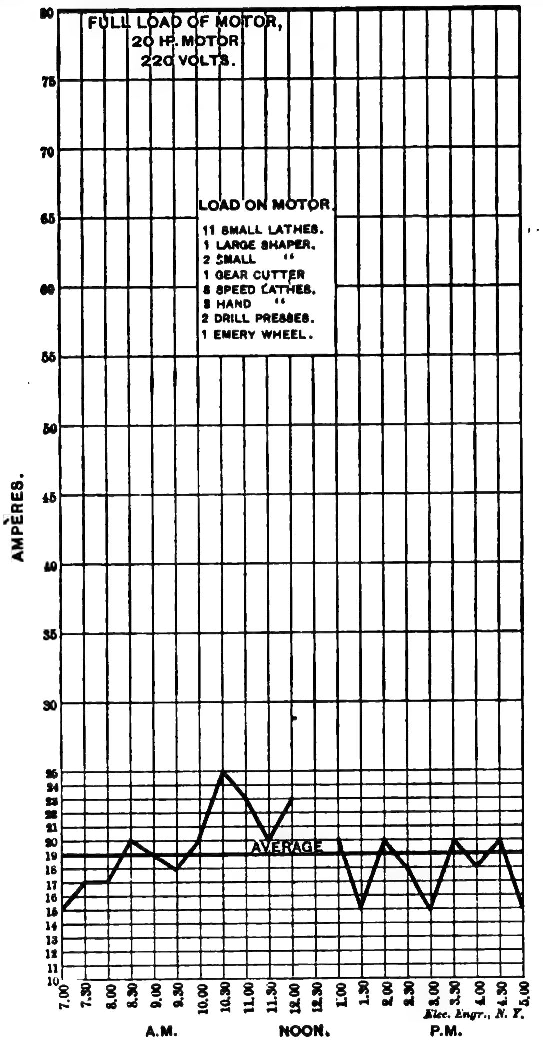
No. 15.

1. A paper read before the National Electric Light Association, Cape May, August 20, 1890.

competition frequently induced by statements of facts and figures showing an utterly false and unattainable economy.

But to the superintendent of the station, more than any other person, these tables would be of paramount importance. They would enable him at a glance to learn what others are actually accomplishing under certain named conditions, and readily to institute comparisons with his own records. By their use he would not only gain enlightenment on many points, but be stimulated to the highest possible degree of efficiency and economy. He would also thus be furnished with unimpeachable authority to offer a doubting stockholder or too exacting president, who, while perhaps not being initiated in the details of practical workings, is always glad to be reassured by accurate information.

These tables would not, however, be found elastic enough to suit the purpose of the energetic boomer whose object in building a station is sale, not operation, for they will be found to show the necessity of the best modern appliances to the most economical



Average Load...... ....24 per cent. of Rated Capacity.
Maximum Load... ... .31 per cent. of Rated Capacity.
Average Load............ ....76 per cent. of Maximum Load.
Shafting... ....79 per cent. of Average Load.

No. 16.

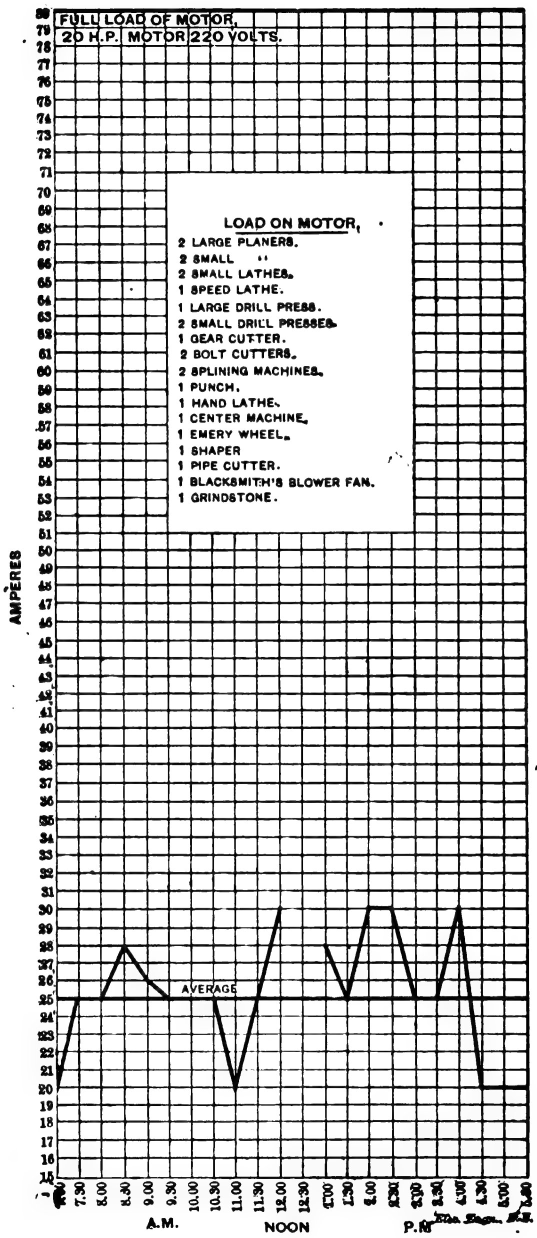
production of power. Neither would they be particularly interesting reading to men who trade in inferior appliances.

A "standard of economy" is obtainable only by a combination of mechanism best adapted to the conditions and attendance which can secure from this mechanism the best possible results. A plant may be equipped with the most improved devices, the excellence of which may be practically nullified by neglect of well-known duties, ignorance or mismanagement. A poor gun in the hands of a good soldier is a better combination than a good gun in the hands of a poor soldier. It is not the machine alone, but combined with the skillful man behind it, that works out the best results.

This point was splendidly taken by Mr. George H. Babcock in his most valuable paper on "Boiler Economy," read before us in Kansas City. We all remember his allusion to "boilers and brains," or the "co-efficient of common sense."

It is perhaps superfluous to mention that results obtained with different existing equipment and attendance vary fully as 1 to 5, with a possibility of the still further lowering of the former proportion by investment in still better equipment constructed by still greater skill managed and operated throughout by superior intelligence, and yet these proportions, which to-day show such wide results in fuel consumption, may, by the combination of intelligence, energy and care, be made to show results more nearly proportioned to the possibilities of the present equipment by placing on record the best results obtained from a similar system.

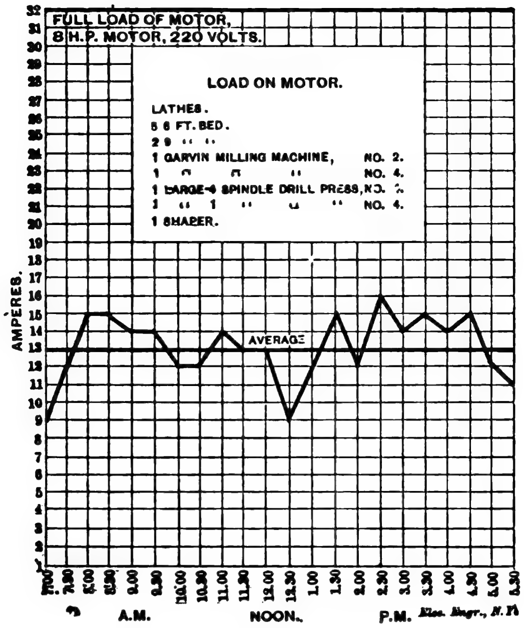
Of course no absolute standard or unit of economy can be established by a vote of convention or fiat of association. A yard stick is a yard stick, an inch an inch, but a standard of economy must always vary in greater or less degree, according to conditions and equipment. Yet a sufficient similarity exists to enable us



Average Load......................32½ per cent. of Rated Capacity.
Maximum Load......................37½ per cent. of Rated Capacity.
Average Load.......................83 per cent. of Maximum Load.
Shafting...........................80 per cent. of Average Load.

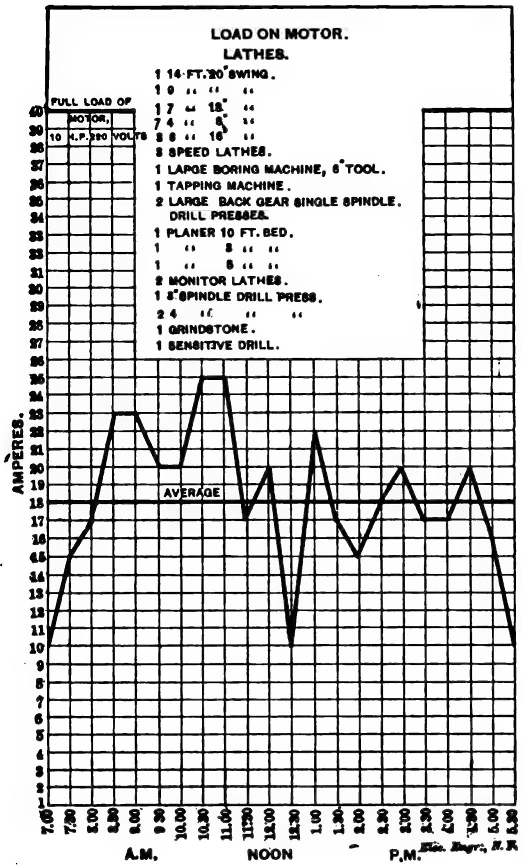
No. 17.

to prepare tables covering the main types of equipment, and the recorded performance of any special type would be relied upon and regarded as a standard. Human ingenuity, talent, patience, skill and incessant labor are being exerted every day and hour in the direction of lowering the records. The ambition of the day is turned towards producing the maximum of result with the minimum of expenditure. Standing in comparison with the fifteen minutes of the ocean racer, the second clipped from the tables of the turf, or the extra grain made to yield from the refractory ore,



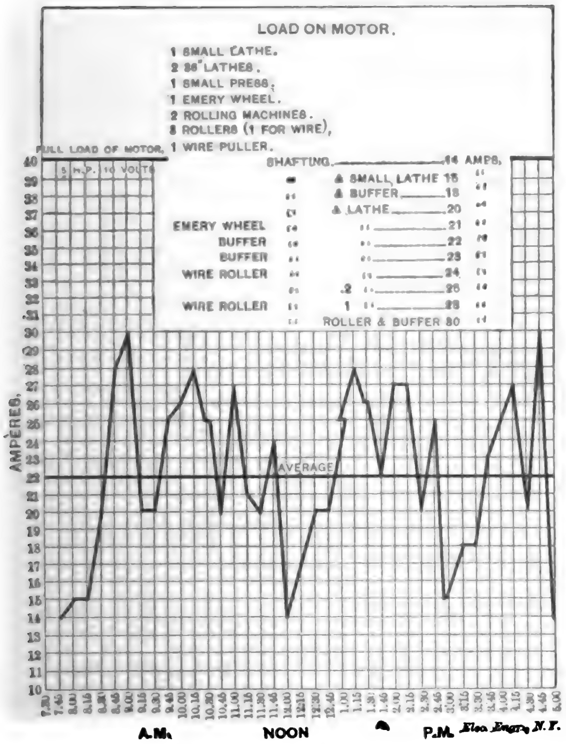
Average Load......................40 per cent. of Rated Capacity.
Maximum Load.....................50 per cent. of Rated Capacity.
Average Load......................81 per cent. of Maximum Load.
Shafting...........................70 per cent. of Average Load.

No. 18.



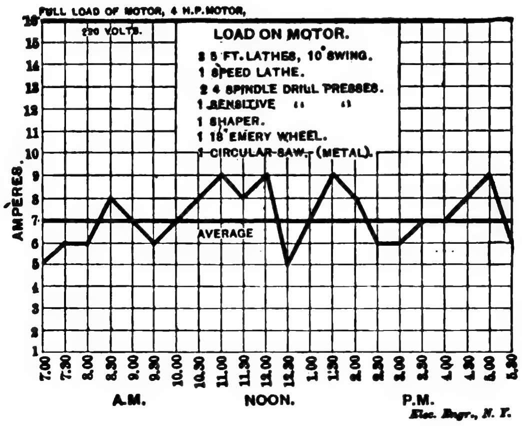
Average Load......................45 per cent. of Rated Capacity.
Maximum Load.....................62½ per cent. of Rated Capacity.
Average Load......................72 per cent. of Maximum Load.
Shafting...........................56 per cent. of Average Load.

No. 20.



Average Load......................55 per cent. of Rated Capacity.
Maximum Load.....................75 per cent. of Rated Capacity.
Average Load......................74 per cent. of Maximum Load.
Shafting...........................64 per cent. of Average Load.

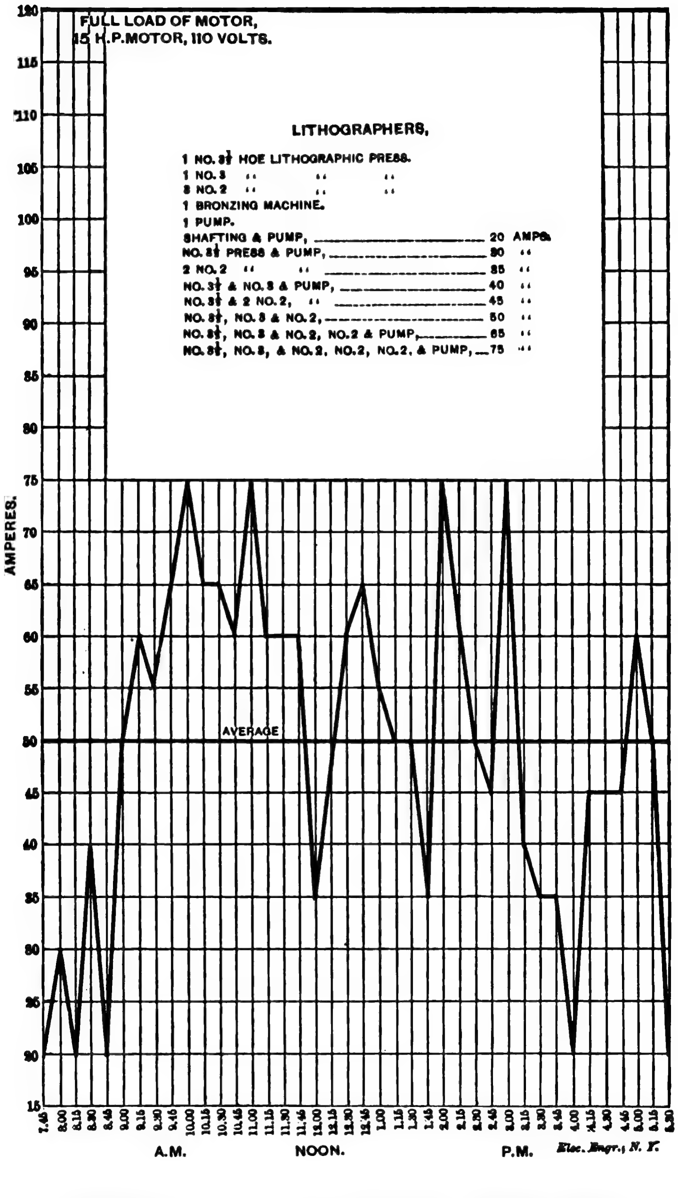
No 19.



Average Load......................45 per cent. of Rated Capacity.
Maximum Load.....................56 per cent. of Rated Capacity.
Average Load......................77 per cent. of Maximum Load.
Shafting...........................70 per cent. of Average Load.

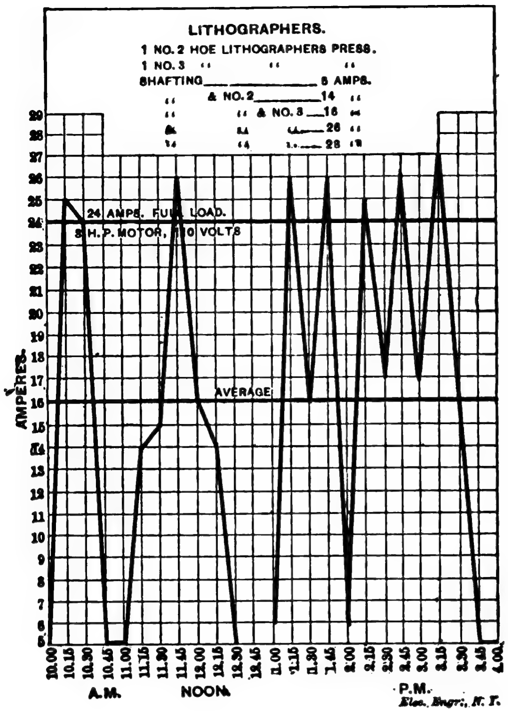
No. 21.

LUFKIN'S LOAD DIAGRAMS OF ELECTRIC MOTOR SERVICE.



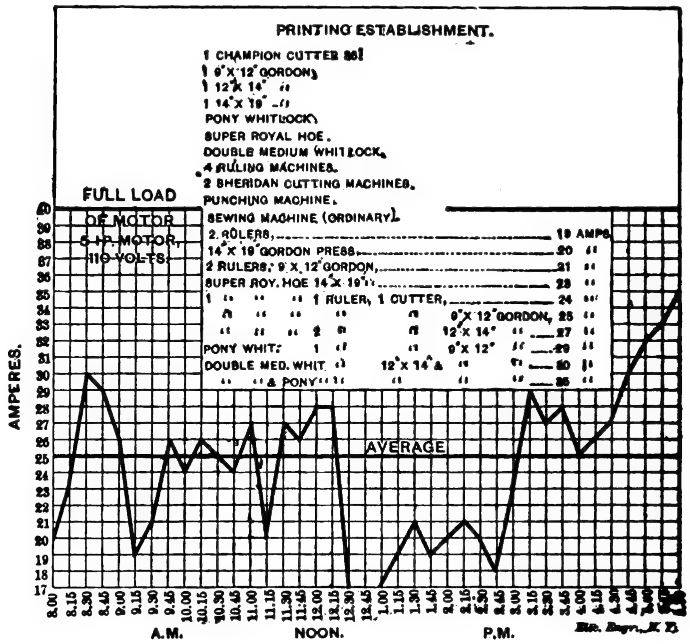
Average Load......................42 per cent. of Rated Capacity.
Maximum Load....................62½ per cent. of Rated Capacity.
Average Load......................67 per cent. of Maximum Load.
Shafting...........................40 per cent. of Average Load.

No. 23.



Average Load......................67 per cent. of Rated Capacity.
Maximum Overload...............12½ per cent. of Rated Capacity.
Average Load......................59 per cent. of Maximum Load.
Shafting...........................39 per cent. of Average Load.

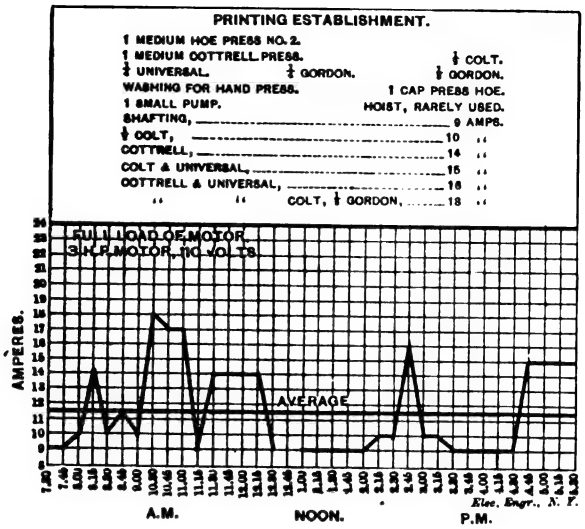
No. 22.



Average Load......................68 per cent. of Rated Capacity.
Maximum Load....................75 per cent. of Rated Capacity.
Average Load......................83 per cent. of Maximum Load.
Shafting...........................71 per cent. of Average Load.

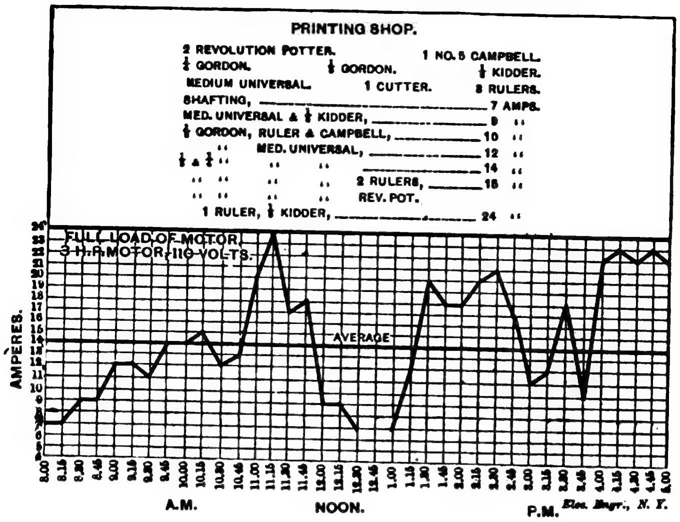
No. 29.

LUFKIN'S LOAD DIAGRAMS OF ELECTRIC MOTOR SERVICE.



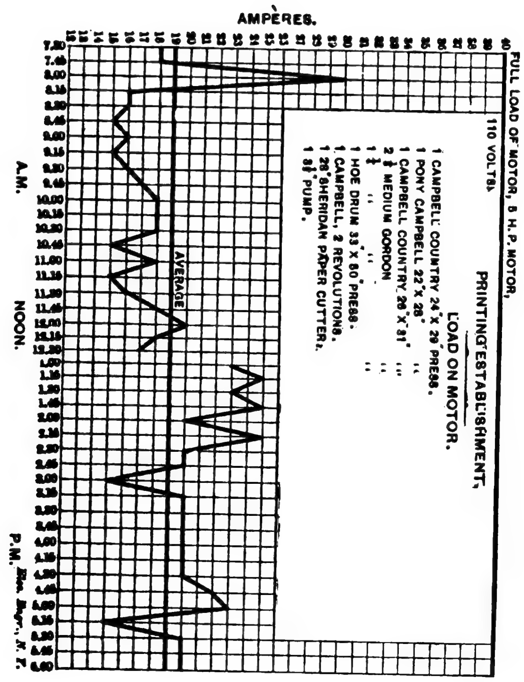
Average Load......................48 per cent. of Rated Capacity.
Maximum Load....................75 per cent. of Rated Capacity.
Average Load......................64¼ per cent. of Maximum Load.
Shafting............................79 per cent. of Average Load.

No. 26.



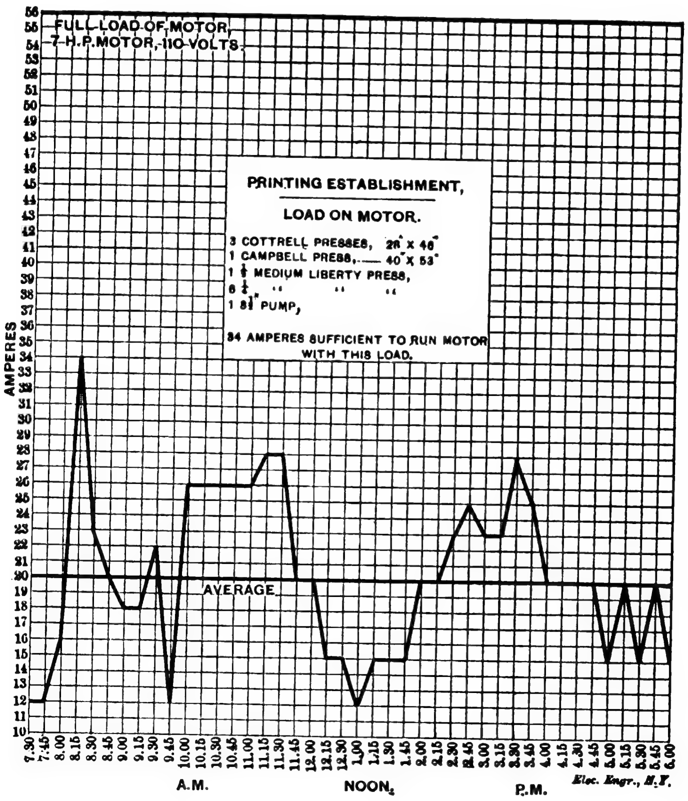
Average Load......................58 per cent. of Rated Capacity.
Maximum Load....................100 per cent. of Rated Capacity.
Average Load......................60 per cent. of Maximum Load.
Shafting............................50 per cent. of Average Load.

No. 24.



Average Load......................48 per cent. of Rated Capacity.
Maximum Load....................75 per cent. of Rated Capacity.
Average Load......................63 per cent. of Maximum Load.
Shafting............................80 per cent. of Average Load.

No. 28.



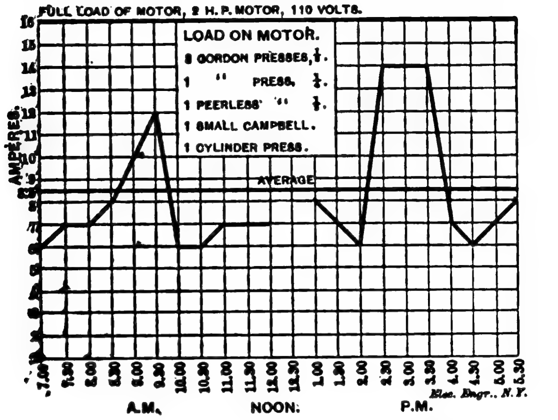
Average Load......................36 per cent. of Rated Capacity.
Maximum Load....................61 per cent. of Rated Capacity.
Average Load......................58¼ per cent. of Maximum Load.
Shafting............................60 per cent. of Average Load.

No. 27.

LUFKIN'S LOAD DIAGRAMS OF ELECTRIC MOTOR SERVICE.

is the ounce of fuel measured in the economic generation of power when considered on the large and increasing scale of commercial enterprise.

My plea is for the most minute and detailed system of tabulation as the means of reaching the best results. It is by the comparison of coal with coal, boiler with boiler, engine with engine, type with type, appliance with appliance, that these results may be obtained. Those who have had experience in collecting data of the kind required will comprehend at once the difficulties encountered in the process of getting information which shall fully cover the many important points in the case. Not only should there be no objection on the part of the companies, their managers or superintendents, to giving information that is reliable in



Average Load........................'3 per cent. of Rated Capacity.
Maximum Load.. ....88 per cent. of Rated Capacity.
Average Load.......................60 per cent. of Maximum Load.
Shafting..............................70 per cent. of Average Load.

No. 25.

character, accurate in detail, and comprehensive in scope, but there ought to be most cheerful acquiescence.

We are organized for purposes of free interchange of thought and experience, with a view to mutual advancement and benefit. In these tables each one is liable to discover information upon some important point which should be of great value to him. Naturally the broad ground of justice, fairness and liberality of feeling is expected to be our starting point.

If I have succeeded in interesting the gentlemen in the importance of "collecting data for these standards," I will feel justified in having consumed the time of the convention. If carried out we will reap the benefit in having on record the facts and figures which have been so often called for; and the answer to the three great questions :—What is your equipment? How many lights do you furnish? How much coal do you burn?

TRIPLE EXPANSION HIGH SPEED ENGINES FOR CENTRAL STATION WORK.[1]

BY E. F. WILLIAMS.

I HAD hoped to get enough accurate data concerning the performance of triple engines to bring before you and to make the subject the basis of a paper, but circumstances have been such that the engine I attempted experimenting on has been so situated that I could not get it rigged up for making the tests, and therefore I cannot give you any accurate data in regard to high speed triple expansion engines for central station work. The main points to be considered in the matter are, however, first, the matter of regulation. Perhaps that is of the highest importance and the matter that is in most question by engineers as to whether there will be a momentary variation in the speed of the triple engines when the load is suddenly increased or decreased that would not occur in single cylinder engine practice. Now that matter depends mainly on the weight of wheel and the intermediate spaces or clearances, and will be modified more or less by the accuracy or quickness of the governor; and as to whether this can be done or not, I will say yes, it can be done. The weight of wheel can be made sufficient, the clearances can be made sufficiently small and the governor can be made sufficiently quick, and it is done so that the engine will not vary materially under sudden changes of load. Of course the smaller the clearances the heavier the wheel, and the quicker the governor the less will be the momentary variation. As to the matter of cost, taking the entire plant considered as a whole, boilers, engines and all, the triple will cost, I presume, approximately 20 per cent. more than the compound. The economy of triple is unquestionably considerably in excess of the compound on the evidences so far taken from marine practice, for example, about 20 per cent. in the compound. It is a fact that compound plants under ordinary circumstances where coal is, say, at an average price of $3 per ton, will consume their entire first cost in about five years' work in coal bills. Assuming that the triple will save 20 per cent. over the compound, the triple would save the excess of cost over the compound in the first year's service.

There is another matter to be considered, namely, the reliability of the machine and the smoothness of action. The triple has advantages over the compound in that respect, theoretically, which, as far as we know of it, practice has sustained. It appears that the triple engine is a much easier engine to care for than the compound. The compound is much easier to care for, ordinarily, than the single, for reasons which are accounted for in theory, and I think the practice will sustain the theory.

1. Delivered before the N. E. L. A., Cape May, Aug. 21.

TWELFTH CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION, HELD AT CAPE MAY, NEW JERSEY.

TUESDAY, AUG. 19, 1890.—MORNING SESSION.

The Association met at the Stockton House, Tuesday, August 19th, 1890, and was called to order by President Perry at 10.30 A. M.

The following members and visitors were present at the convention:

ALLEGHENY, PA.—A. Groetzinger.

ANSONIA, CONN.—F. B. Platt.

ATLANTA, GA.—John S. Alfred.

BOSTON, MASS.—P. H. Alexander, G. L. Austen, F. E. Barker, S. E. Barton, Capt. Wm. Brophy, A. N. Burbank, Louis W. Burnham, C. L. Edgar, F. E. Cabot, Wm. W. Castle, H. J. Conant, H. E. Duncan, H. H. Eustis, H. M. French, A. V. Garratt, C. M. Goddard, L. H. Hart, J. R. Lovejoy, A. F. Mason, E. C. North, F. E. Pettingell, R. F. Ross, A. C. Shaw, R. T. White.

BRIDGEPORT, CONN.—W. C. Bryant, J. M. Orford, O. S. Platt, H. D. Stanley.

BRISTOL, PA.—Chas. E. Scott.

BROOKLYN, N. Y.—E. F. Peck.

BUFFALO, N. Y.—C. Lee Abell, C. R. Huntley, W. H. McDonald.

CHICAGO, ILL.—W. P. Adams, J. P. Barrett, John W. Blaisdell, Chas. A. Brown, E. V. Cavell, Geo. Cutter, J. W. Dickerson, Fred. Degenhardt, Henry C. Eddy, C. E. Gregory, W. A. Kreidler, Geo. A. McKinlock, E. L. Powers, J. W. Shay, J. H. Shay, H. H. Small, Gilbert M. Smith, Ed. F. Williams, C. H. Wilmerding, H. S. Winston, F. A. Wunder, John Young.

CAMDEN, N. J.—Hon. E. A. Armstrong, J. J. Burleigh, C. L. Rodman, Heber C. Robinson.

CINCINNATI, O.—James Powell.

CLEVELAND, O.—C. C. Curtis, W. B. Cleveland, J. B. Crouse, Benj. F. Miles.

COLORADO SPRINGS, COL.—E. C. Wade.

DALLAS, TEX.—W. M. Clower, C. O Harris.

DETROIT, MICH.—Jesse M. Smith, Fred. Whipple.

ELGIN, ILL.—G. S. Bowen.

FITCHBURGH, MASS.—H. F. Coggshell.

FLINT, MICH.—A. G. Bishop.

FT. WAYNE, IND.—W. R. Kimball, M. M. M. Slattery.

HARTFORD, CONN.—W. G. Halm, C. L. Tolles, Francis P. Whiting.

KANSAS CITY, MO.—M. E. Bates, G. W. Hart, Geo. H. Hegeman, E. R. Weeks.

MONTREAL, QUE.—A. J. Corriveau.

NEWARK, N. J.—C. O. Baker, Jr.

NEW BEDFORD, MASS.—Chas. R. Pine, Mr. Underwood.

NEW BRITAIN, CONN.—T. H. Brady, L. C. Whitney.

NEW ORLEANS, LA.—S. J. Hart.

NEW HAVEN, CONN.—J. English, C. D. Warner.

NEW YORK.—P. C. Ackerman, F. M. Adams, E. P. Atkinson, C. H. Barney, Wm. Bracken, L. D. Beck, Louis Bell, Edward Caldwell, W. L. Candee, Stephen L. Coles, Francis B. Crocker, W. F. Cullen, C. J. Field, G. H. Fisher, W. H. Fleming, A. R. Foote, R. E. Gallaher, E. T. Greenfield, J. W. Godfrey, R. J. Gray, W. H. Gordon, Wm. J. Hammer, Geo. H. Hartwell, H. M. Haines, W. J. Jenks, E. H. Johnson, W. J. Johnston, Jas. F. Kelly, Theo. Larbig, A. B. Laurence, H. Ward Leonard, E. W. Little, H. L. Lufkin, O. E. Madden, J. P. McQuade, Frank A. Magee, Geo. T. Manson, T. C. Martin, Geo. H. Meeker, T. McCoubray, W. J. Morrison, E. Myerson, Geo. M. Phelps, Chas. A. Place, Geo. B. Prescott, Jr., C. W. Price, R. W. Ryan, J. R. Stagg, John A. Seely, L. W. Serrell, Ralph L. Shainwald, H. L. Shippey, C. W. Spear, C. E. Stump, H. M. Swetland, J. B. Taltavall, Robert Taber, Wm. H. Temple, J. Van Gestel, C. S. Van Nuis, F. Warder, Jean A. Wetmore, Benj. R. Western, Jos. Wetzler, S. S. Wheeler, G. L. Wiley, Harry W. Williams, E. E. Wood, E. P. Wisner and C. G. Young.

NORTHEAST, PA.—A. L. Daniels.

ORANGE, N. J.—Chas. Wirt.

PHILADELPHIA.—Henry N. Almy, C. A. Bragg, David Brooks,

H. A. Cleverly, D. O. Conner, W. A. Drysdale, A. J. De Camp, F. H. Deacon, W. R. Hood, Norman Marshall, W. McDevitt, W. C. McIntire, Alfred F. Moore, H. G. Morris, Geo. F. Porter, O. D. Pierce, H. S. Smith, T. C. Smith, W. A. Stadleman, W. H. Shoemaker, G. A. Wilbur, Elmer G. Willyoung.

PITTSBURGH, PA.—H. L. Angloch, S. A. Duncan, A. E. Carrier, J. W. Marsh, Morris W. Mead.

PLANTSVILLE, CONN.—H. C. Roberts.

POTTSTOWN, PA.—Chas. E. White.

PORT HURON, MICH.—W. F. Davidson.

PROVIDENCE, R. I.—Marsden J. Perry, Geo. H. Wood.

RUTLAND, VT.—M. J. Francisco.

SAN FRANCISCO, CAL.—Geo. H. Roe.

ST. LOUIS, MO.—Robert McMath, C. C. Moffitt, Russell Parker, D. R. Russell.

TOLEDO, O.—C. R. Faben.

TRENTON, N. J.—F. A. C. Perrine.

WATERBURY, CONN.—A. M. Young.

WILMINGTON, DEL.—H. B. Cobb.

WINDSOR, CONN.—M. E. Baird, A. D. Newton.

WASHINGTON, D. C.—F. W. Royce, A. M. Renshaw.

WORCESTER, MASS.—H. M. Smith.

The ladies attending the convention were as follows:

Mrs. G. L. Austen, Mrs. P. H. Alexander, Miss E. W. Armstrong, Mrs. C. O. Baker, Mrs. C. H. Barney, Mrs. Chas. A. Bragg, Miss Myrtis Barton, Mrs. S. E. Barton, Mrs. J. J. Burleigh and daughter, Mrs. J. P. Barrett, Mrs. W. L. Candee, Mrs. Wm. M. Castle, Mrs. Geo. Cutter, Mrs. A. J. De Camp, Mrs. C. R. Faben, Miss M. B. Ford, Mrs. M. J. Francisco, Mrs. R. E. Gallaher, Mrs. G. W. Hart, Mrs. Harris, Mrs. E. H. Johnson, Mrs. W. J. Johnston, Mrs. Jas. F. Kelly and child, Mrs. W. R. Kimball, Mrs. E. W. Little, Mrs. Geo. T. Manson, Mrs. A. F. Mason, Miss Kate Mitchell, Mrs. W. C. McIntire, Mrs. J. P. McQuade, Mrs. J. M, Orford, Mrs. F. E. Pettingell and Master Roger Pettingell, Mrs. G. B. Prescott, Jr., Miss Ridlon, Mrs. John A. Seely, Mrs. M. M. M. Slattery, Mrs. W. A. Stadleman, Mrs. C. D. Warner, Mrs. E. R. Weeks and child, Mrs. Schuyler S. Wheeler, Mrs. Fred Whipple, Mrs. Geo. H. Wood, Mrs. John Young, Mrs. Lenox and Miss Lenox.

The president read the following address:—

PRESIDENT PERRY'S ADDRESS.

You are here to-day to erect, by mutual action, another milestone—in the form of the volume that will be created to contain a record of your proceedings—to mark the progress of the development of the electrical industries. Short as the history of this development is, it has been so crowded and broadened by the eager enterprise that is characteristic of our people, that no records are to-day sufficiently ample and complete to give any of us a correct knowledge of the present condition of the multitude of undertakings employing electricity in some form of practical application.

To supply this deficiency a "Memorial and Statement" has been presented to Congress in the name of this association, urging that the fullest possible investigation and report be made on the electrical industries by the eleventh census. This association can do no more important work for the interests it represents than to select from the census reports certain points of inquiry, and adopt measures to keep them continuously written up to date. Recommendations looking to this end may be presented by the committee on data.

As a general statement it may be assumed that there is to-day a central lighting and power station in operation in every town of any importance in the United States. An estimate made by, and published in, the August number of *Electrical Industries* makes the following showing:—

Number of stations	1,379
Capital invested	$118,758,500
Number of arc lights	127,441
Number of incandescent lights	1,590,967
Engine capacity, h. p.	356,755

Eloquent as these figures are of enterprise and progress, they tell but part of the story. One startling omission is that of the electrical transmission of power for stationary and locomotive work. The statements, however, may serve the purpose of helping the imagination to picture the results that are to be shown by the census of the century in the year 1900.

It is a safe assertion that there is not a station in this country with a present capacity sufficient to satisfy one-twentieth of the demand for light and power, that exists within the area of its practical working limits. To reach the consummation of ultimately doing the entire lighting and power service that is to-day being supplied by the use of agents other than electricity, is an undertaking worthy of the united efforts of all who are interested in the electrical industry. The foundation for such a growth must be laid in an unquestioned demonstration that investments in central stations for supplying light and power by the use of electrical currents, are safe and profitable, that the service is—in comparison with that rendered by other agents used for similar purposes—a protection to life and property, and that the service can be employed with advantages in economy, health and comfort, by all users that cannot be realized by the use of any other agent.

Those who know best what is required to meet all issues and to establish a business involving the complex factors and conditions assembled in undertakings for central station work, are those who have invested their money in it and are employed daily in its management. To them and their interests, which includes that of all who manufacture apparatus and supplies, as surely as the greater comprehends the lesser, this Association is pledged for well-considered and effective work.

In your deliberations and discussions you have an opportunity to show your thorough knowledge of the subjects in which you are interested. By your actions you can prove yourselves masters of the factors that induce progress and invariably lead to successful issues.

The Twelfth Convention of the National Electric Light Association is now open for the consideration of such subjects and business as may come before it.

The secretary read the following announcement of the order of business:

For the purpose of securing orderly and prompt action for those attending the Twelfth Convention, the Executive Committee has appointed a Committee on Credentials, the members of which are:

Edwin R. Weeks, Chairman; M. J. Francisco and John A. Seely. The committee recommends the appointment of a Committee on Resolutions to consist of three members. The Executive Committee believes that many questions that can be discussed with great profit to members of this Association do not come to the surface in set papers, nor in the reports of committees. That every such question may be considered a call for "Topics to be Discussed," will be made at each session except the last. All topics so proposed will be referred to the Committee on Resolutions, and, if approved, a place will be found for the topic in the order of business.

MR. FABEN, of Toledo, moved that the recommendation read by the secretary be approved, and that the chair appoint a committee of three on resolutions. The motion was carried and the president appointed as such committee Messrs. A. F. Mason, C. H. Wilmerding and C. R. Huntley.

The paper by Prof. J. P. BARRETT, of Chicago,[1] was then read by Mr. Blaisdell, and was discussed as follows:

MR. FABEN—There certainly will be no one enterprise presented at the World's Fair that will interest central station men as much as will the electrical department. The amount of detail required to develop a proper exhibition of the appliances presented there, and to induce manufacturers to present those features of their business that will be not only of interest to themselves but to central station people as well, and the amount of work involved in the undertaking, demands that action should be taken by this Association now. This being a central station association, the central station people ought to go to work very promptly to lay plans for securing a proper exhibition at that time. For that purpose I would like to present a motion as follows:

That a committee of five be appointed, of which number the president of the association shall be ex-officio one, the other four members to be appointed by the chair, to meet the authorities of the Columbian Exposition and secure suitable facilities for the proper exposition of electrical manufactures and appliances, and, in general, to work for the interests here represented, and to offer to the authorities of the exposition the co-operation of the National Electric Light Association to aid in making the exposition a success.

That the committee request the selection by the authorities of the Columbian Exposition, of Mr. John P. Barrett, of Chicago, to have the practical charge and control of the electrical department of the World's Columbian Exhibition.

MR. G. M. PHELPS, of New York—I have great pleasure in seconding the resolution which Mr. Faben has offered and both features of it: That is, the appointment of a committee to secure suitable facilities, and tendering the co-operation of this body with the authorities of the Fair, and also recommending the appointment of Mr. John P. Barrett. The paper which has been read to us this morning is about as good evidence as we might need, perhaps, of the fitness of Mr. Barrett for that work, although doubtless most of us knew that well enough before. A further reason is that Mr. Barrett has already been commended to the World's Fair Commissioners by the signatures of very many of the most prominent electrical people, electricians, electrical engineers, manufacturers and users of light and power. I think that it would be eminently fit and proper for this Association to take such action at this time as has been proposed. The sooner such action can be had the better it will be for the exhibition. I presume that there is no doubt in the mind of any member of this Association of the entire fitness of Mr. Barrett for the position. I therefore second the motion.

MR. ARMSTRONG, of New Jersey—I am most heartily in favor of all of the resolution except that part of it which recommends the appointment of some particular individual. I think that this

1. See page 207.

Association would make a serious mistake if it did that thing. I have myself recommended the appointment of Prof. Barrett, and personally I am heartily in favor of his appointment, and personally am willing to do everything possible to secure that appointment; but it seems to me that the Association would be making a serious mistake if it lent itself to a recommendation of any individual for any appointment. (Applause.) I should be very sorry to see this Association join in recommending anything where there is a possibility of there being, with merit, some competition against it; and I believe that every member of the Association would join with me in deprecating the recommendation of anything, no matter how good it might be, if, with merit, some competition could be brought against it. We want to be in the position, beyond any question or any cavil, of disinterestedly and impartially standing here as representing all and everything connected with the industry with which we are associated. We do not want to have the slightest possible suspicion that we are biased in any direction. Therefore, I am very glad to vote for this resolution if we may have that part of it omitted. I may say to the gentlemen who have moved and seconded the resolution that I am willing to join with them, individually, in doing everything possible to have the gentleman who has presented such an interesting paper to us appointed to the position they desire to see him appointed to; but do not let this Association adopt such a resolution. It would be weakening to us, and I think it would be weakening to him. (Applause.)

MR. P. H. ALEXANDER, of New York—This morning I received a copy of the electrical journal of the West, *The Western Electrician*, and its first editorial speaks about mistakes having been made by the Association here at a former meeting at which the Association voted to have the World's Fair held in New York instead of in Chicago (Laughter); and especially recommends that we take no action whatever, and do not commit ourselves further in any way whatever, without first having due deliberation. Now the resolution offered by Mr. Faben, and seconded by Mr. Phelps, coming immediately after the paper by Prof. Barrett was read, puts Prof. Barrett himself in rather a delicate position. His paper speaks particularly of the advantages that could be derived by the proper arrangement of electrical exhibits at the Chicago Exhibition; and I do not think that he himself would like the resolution to come up now, at least not in that form. If notice had been given by these gentlemen that such a resolution would be brought up in the course of the session it would have given opportunity to gentlemen who are interested in the subject to confer with each other regarding a proper appointment. I therefore move that that resolution be tabled.

MR. F. E. DEGENHARDT, of Chicago—I would be untrue to the city of Chicago, and to my friend Prof. Barrett, if I did not raise my voice in support of his appointment. As I understand it, the resolution has for its object the successful operation of the World's Fair. In the appointment of a neutral man like Prof. Barrett, we have in him all the qualifications set forth in the resolution; and I would like to add that the very support which has been granted to him by signatures throughout the United States is a sufficient guarantee of the feeling which must exist. Of course we Westerners recognize the fact that you are dying very hard back here, and the World's Fair seems to be the red flag that excites the bull, so to speak. Prof. Barrett is known throughout the United States as an absolutely neutral man. I I think that he is free and untramelled. He has no affiliations that we know of, and is therefore a man qualified for the position. I think that this Association owes the city of Chicago as a debt the adoption of this resolution.

MR. S. A. DUNCAN, of Pittsburgh—As a substitute for the pending motion I move to refer these resolutions to the committee already appointed by the chair.

After some debate by Messrs. De Camp, Alexander, Armstrong and Brown, the motion was carried and the resolution referred to the Committee on Resolutions.

THE PRESIDENT—The next order of business is the report of the Committee on Copper Tariff, by Mr. Charles A. Brown, of Chicago.

REPORT OF COMMITTEE ON COPPER TARIFF.

MR. C. A. BROWN, of Chicago—We had expected that by this time Congress would have passed a tariff bill, and that thus there would be some definite result with reference to the duty on copper, in securing which the committee could claim some part. But you all know what the present situation regarding the tariff bill is. The original bill introduced by the Committee on Ways and Means provided for a reduction of fifty per cent. of the duty on various forms of copper. This provision of the bill as introduced into the House was not changed in the House. In the Senate the clause relating to the duty on copper was amended by further reducing the duty to one-half cent per pound on ores and one and one-quarter cents per pound on ingots, bars, plates, and pigs, being a reduction of seventy per cent. in one case and eighty per cent. in the other from the present schedule of duties. It is reasonably sure that if the Tariff Bill becomes a law at the present session of Congress the duty on copper will be reduced at least fifty per cent. Your committee has secured something over five hundred signatures to a petition addressed to the Committee on Ways and Means requesting the abolition of the duty on copper. We have mailed something over a thousand circular letters, and have made in addition to that a good many personal solicitations. Mr. Phelps, of the committee, personally went to Washington with the signatures to this petition and presented them to the Committee on Ways and Means, with a brief but forcible argument in favor of the petition. As no appropriation was made by the Association to meet these expenses, the members of the committee themselves advanced the necessary money for postage, traveling expenses, express, etc., to the amount of $110, in carrying out what seemed to them to be the spirit of the instruction contained in the resolution on appointing this committee.

MR. A. J. DECAMP moved that the report be accepted and the committee continued. The motion was carried.

MR. P. H. ALEXANDER—Moved that the treasurer be instructed to reimburse the committee for its outlays of $110. This was carried.

MR. DECAMP—I want to give notice of my intention to offer a resolution to reconsider the action taken by the Committee on Resolutions. My reason for offering that is this: While the plan proposed is a most admirable way of presenting the business for a body that has unlimited time to discuss and get through with its business, I think if that resolution prevails that we will do very little business in the three days in which we meet to transact our business. I think it is too cumbersome for this association.

THE PRESIDENT—I wish to announce that the following topic has been proposed for discussion: "The Proper Classification of the Lighting Power of Incandescent Lamps." Dr. Louis Bell, editor of *The Electrical World*, will open the question. The announcement is made in advance, so that all who desire may have an opportunity to be present and take part in the discussion. I think it is important.

The Association then adjourned until 4 p. m.

TUESDAY AFTERNOON SESSION.

Called to order at 4 P. M.

The President opened the session by reading a telegram from Mr. M. D. Law, of Denver, Col., wishing success to the convention and regretting his inability to be present.

THE PRESIDENT—The first thing on the opening of this session will be a five minutes' talk by Mr. David Brooks, of Philadelphia, on

THE USE OF LIQUID INSULATION FOR UNDERGROUND CONDUCTORS.

Since electric lighting came into use it has been found that the ordinary tests for insulation do not apply; that is, a test with a galvanometer and a voltaic battery of, say, 1 to 500 cells. That has become apparent, and they have adopted other means in Paris and in London for testing the insulation of conductors that have to carry very high intensity currents. We have seen this noticed in many periodicals. Mr. William Maver, Jr., in a recent article states that a cable measuring 20,000 megohms per mile, for insulation in the factory, broke down by a dynamo current of 600 volts after being drawn into a conduit. Now in the ordinary test, if a person should go and measure the insulation of an electric light cable and he found that it was 20,000 megohms per mile, and he took another system of insulation and found that it was only half a megohm per mile, as a general result he would take that which stood 20,000 megohms to a mile; but if you apply to it a current of high voltage from an induction coil or a Holtz machine, you can prove that the one with the 20,000 megohm insulation per mile was broken down by from 5 to 10,000 volts. Now you take the same No. 4 conductor and insulate it in oil for 20 feet, just as an experiment, and raise the temperature to 200 Fahrenheit and apply the galvanometer, and it is not a half a megohm per mile—just about the one-fortieth part of the one that Mr. Maver speaks of; but when you come to apply the induction coil or the Holtz machine and test it to produce what is sometimes called the break-down or a disruption, it can be broken with 10,000 volts when the other can not be broken with 500,000 volts. There is the difference between the testing of the insulation of a cable, or an insulator, or a dielectric, if you please, by testing it with the ordinary delicate galvanometer, static galvanometer, and testing it for standing a current of high voltage. Now if the current applied to a conductor tests half a megohm per mile, the temperature of the insulation being 212 Fahrenheit, that would not show much; no one on first sight would buy it; but if you are going to purchase a cable and test it as they do in England, or give the guarantee as they do now in England, there would be five parts of current going through the insulation, to 500,000 parts going through the conductor; and the small proportion that goes through the insulation is a mere bagatelle, but it stands the current. These are experiments that I have made in Philadelphia and I would do it here with a Holtz machine, but the atmosphere in the summer and especially on the sea shore is very unfavorable to the use of a Holtz machine. (Applause).

The paper on "Dangers from Electricity,"[1] by Prof. Henry Morton, of the Stevens Institute of Technology, Hoboken, New Jersey, was then read by Mr. Alexander.

1. See page 208.

In the discussion, Mr. W. R. Freethy, of the Employer's Liability Assur. Co., of Boston, remarked that it was the object of his company to bring about a better condition of things than exists at the present time in connection with the instructions to employés of electric light companies with regard to the dangers which surround them in carrying on their daily operations. When his company started in business here a few years ago they found that, in consequence of its being the first one to introduce what is known as employer's liability insurance in the United States, they had really no experience to guide them upon which they could found rates of premium for the various electrical risks. They therefore established what they considered to be a fairly reasonable rate to charge the electric lighting employers in order to protect them with regard to their legal liability for accidents to employés. But, in the course of a short time they found that the rate was inadequate. They found that several serious accidents occurred amongst their policy holders, and, what was of greater importance to them in carrying on their business, they found that the prejudice of the public, which was aroused by the press from time to time, whenever an accident occurred, made it impossible to carry that case before a jury.

The result was that they were compelled to increase their rates of premium by nearly 100 per cent. They then set themselves to try to find out whether they could do anything to bring about a better state of things, so as to reduce the rate of premium charged to electric light companies. They accordingly issued a circular to their policy holders, asking them to send them copies of their regulations for the guidance of employés in carrying on their work. All these regulations, and the matter generally, were submitted to Prof. Henry Morton, for his consideration. He drew up the set of regulations which are contained in the paper, and the company consider them very good.

In answer to a question from Mr. M. J. Francisco, Mr. Freethy said that the premium is based upon the wages or upon the payments. They charge one and one-half per cent.

Mr. Francisco characterized the action of the company in raising the rate, in face of the good showing of only 16 per cent., of accidents due to the current, as unjust to the electric light companies.

Mr. P. H. Alexander then offered the following resolution:

Resolved, That it is the sense of this Association that a copy of the rules prepared by Professor Morton, as embodied in the paper read before the meeting to-day, ought to be conspicuously posted in every electric light station.

The resolution was seconded and unanimously adopted.

Mr. E. A. Armstrong, of Camden, remarked that for over five years he had operated a station and had no accident of any kind, with but one single exception, namely that of a door of the boiler room which fell down on one of the employés and hurt him somewhat, but which would hardly be charged against the electric light station.

Mr. Armstrong then moved that the Committee on Data be requested to examine into and report all accidents happening in electric light stations, and to what they may be attributed. The motion was carried.

Mr. J. A. Seely, of New York, moved that a vote of thanks be extended to Professor Morton for his valuable paper and that the secretary be instructed to print the same in the proceedings. Carried.

Mr. Geo. Cutter, of Chicago, then presented the report of the Committee on National Insurance Rules.

REPORT OF INSURANCE COMMITTEE.

Your committee have at this session simply to report progress, as the object for which it considers itself appointed has not been completed, viz., the codification of a set of rules regarding electric light and power installations which shall become national in character, and be used instead of the many sets of rules put forth by the different insurance associations throughout the country.

We have written the following letter to many insurance associations throughout the United States:—

"*Dear Sir:* At the last meeting of the National Electric Light Association in Kansas City, a committee was appointed to select delegates or representatives from the different insurance associations in the country, and also from the electric light companies to a national electric insurance committee. This committee will probably consist of eleven or thirteen members, the majority to be insurance men. They are to devise a set of insurance rules concerning electric light installation which shall be enforced all over the country. It is found at present that different rules are in force now in the different parts of the country, and in many places two sets of rules, more or less conflicting, cover the same territory. We hope to remedy the evils of this by devising one set and have this set supported by insurance men throughout the United States.

"In order to have these rules the best for the purpose, they should represent the average opinion of the various men who have had experience in this particular line, and also who represent the different interests involved. It is our aim to get a committee thoroughly well balanced as to the conflicting interests, so that the resultant opinion of them all will be so strong an expression of the best methods for electric work as to meet the support of all the insurance people and the electric light people also.

"We wish you would name your choice as a representative upon this committee. We are already accumulating a great deal of information on insurance rules all over the world, so that when this committee hold their meeting they will have the work so far advanced that a good set of rules can be arranged without very much delay.

"As there are many electric light inspectors who have had valuable experience and understand the subject pretty well, whom we expect to have upon this committee, we feel that such committee will be a great benefit both to insurance and electric light interests. It is our ambition to have this committee so carefully selected that it will become a body of referees to settle all important questions arising in relation to proper electric work. We trust you will realize the importance of this, and give it prompt and careful attention, and be prepared to support the decision of such a committee.

"Hoping to hear from you soon, and to have your support in this valuable work, we remain, etc."

The answers to these letters were almost universally favorable, and contained many expressions of appreciation on the part of the insurance people of the efforts made by this association to work in harmony with them in devising these rules and in advancing information leading towards good and safe construction.

You can, of course, readily understand that it has occupied much time and correspondence to determine just what associations to approach, and how to approach them, and get them to fully understand our object, in order that they should send a representative to act upon this committee. As a result of this work we have the pleasure of informing you that the following gentlemen have come to Cape May as representatives of the various associations and companies named:

COMMITTEE ON NATIONAL INSURANCE RULES.

George Cutter, Chairman.

COMPANY.	REPRESENTATIVES.
Edison	W. J. Jenks.
Thomson-Houston	J. R. Lovejoy.
Westinghouse	P. H. Alexander.
Engineering Firms	T. Carpenter Smith.
Electrical Supplies	George Cutter.
Phila. Bd. of Fire Underwriters	Wm. McDevitt.
New York Bd. of Fire Underwriters	Wm. D. Boughton.
Underwriters Assoc. of Mid. Dept.	H. O. Kline.
Nat. Bd. of Fire Underwr's N. Y.	A. A. Anderson.
Asso. Factory Mutl. Ins. Co., Boston	Capt. Wm. Brophy.
Boston Bd. of Fire Underwriters	F. C. Cabot.
Western Union Fire Underwriters Association	C. E. Bliven.
Cleveland and Chicago Boards	John P. Barrett.
St. Louis Board	Robert H. McMath.
Central Station Insurance	S. E. Barton.
New England Insurance Exchange	C. M. Goddard.
Southeastern Tariff Association	John S. Alfred.
Underwriters Assoc. of N. Y. State	— Babcock.

These gentlemen have been in session most of the time for several days discussing the different rules, and laboring to outline a framework, so to speak, or what they term generic rules. It was the general feeling that these rules should be made concise, and as few as possible, and still cover the basic principles of good work.

Your committee have the pleasure of stating to you that the insurance representatives were quite generally agreed with a feeling of good-will towards electric light and power installations, and they do not feel afraid of them.

The deliberations upon these set of rules have been referred to a sub-committee for further study, both to eliminate any mistaken positions, and also to frame them in proper wording.

They have also taken the necessary steps to communicate with one another for the purpose of arranging these rules so they can meet the approval of the different representatives and be adopted in place of the rules now in force. It is the opinion of these gentlemen that this work will be accomplished, and that they will enable your committee to report to the next meeting of this Association the uniform set of rules that you have wished for, and also that they will be supported by the various insurance associations.

It was voted at the last meeting that we should express to you their appreciation of your efforts to work in harmony with them in this direction and assure you of their good-will and reciprocity of feeling in the same line.

Your committee have also corresponded with various European authorities to learn their methods of inspection, and also to secure copies of the rules they have in force, and we have in our possession various sets of rules from England, France, Germany, and Italy, and these sets of rules, with their accompanying information, will probably influence to a considerable extent the rules which we will adopt. The force of this can be especially appreciated by quoting part of the report of the committee on light-

ing, heating, and patents, appointed by the National Board of Fire Underwriters, which report was presented to the National Board last winter.

"The great problem before us to-day, however, is the management of the various systems of electric lighting so as to ensure safety from fire. When such lights were first introduced, underwriters congratulated themselves that at last the long sought means of illumination without danger had been found. No matches, no kerosene explosions, no swinging gas brackets would hereafter vex them, but a steady, safe and brilliant light, which could do no possible harm, had come among us and all were happy.

"It did not take many months, however, to discover that the electric light was not the harmless thing we had imagined, but that it was a most prolific source of danger, and its introduction has cost the insurance companies more than any method of lighting heretofore in use. It has come to stay, and sometime it will probably be as safe as any light in use, but our knowledge of its properties and of its management must be vastly increased before that time appears. We see the danger, but as yet are too ignorant to point out the remedy. What yesterday seemed a safe method of installation, to-day proves dangerous, and what we regard as safe to-day is likely to develop danger to-morrow. We can only wait and study.

"For a number of years the National Board has followed the action of the New York Board in the matter of rules of regulating electric light equipments. Those rules were revised and re-issued by that Board, Jan. 15, 1890, and it is recommended that they be adopted by this body as thus revised, and promulgated to members.

"In this connection, it is proper to say that the National Electric Light Association, in a letter appended to this report, asks the National Board to nominate a representative upon a committee to be drawn from bodies of underwriters, and electrical experts in different parts of the country, to devise and recommend rules for electric light installations, which shall be uniform throughout the land, and tend to throw safeguards about the use of such lights. Your committee recommends that the invitation be accepted, and a representative appointed. Certainly nothing but good can come out of the deliberations of such a committee, and it is necessary that we should in every way increase our knowledge of what has become so important a factor in our business, and if possible, remove some of the dangers now attending it.

"Precisely what is expected of this committee in regard to the third topic named in this report, viz., "Patents," they are unable to say, but nothing in this department has been brought before them which seems to require any report."

And then to show the opposite opinion held by insurance companies in Europe, as well as many in this country. The Phœnix Fire Office Rules of London were issued in 1882, and their edition of 1889 contains the following statements, viz: "Notwithstanding the number of years that these rules have been in force, not a single fire has yet occurred from any electric installation that has been placed up in compliance with them. The electric light is the safest of all illuminants, and is preferable to any other when the installation has been thoroughly well put up."

The electric light and power interests are of great importance in Italy, and the only rules in force in that country are those established by the government to protect its telegraph and telephone circuits. There are no insurance rules in Italy, and no insurance inspection of electrical installations, and places lighted by electric lights have the benefit of a diminished rate. In conclusion, gentlemen, your committee respectfully ask for more time to complete their work.

The report was received and filed and the committee continued.

In the discussion, Mr. S. A. Duncan referred to the two diametrically opposite quotations from the Underwriters' reports, and he hoped that this committee, in its pursuit of facts, would so sift the insurance statements that when the committee came before the Association again they would be able to say from their own standpoint what were facts and what were not.

Mr. P. H. Alexander said that the reason why the Phœnix rules showed such good results is because on the very first page is printed a very terse sentence, and very much to the point, viz., "In examining your tenders for work from different electric companies be careful not to accept the lowest tender until you have thoroughly examined all, and find that the work will be done just as good at the lowest figure as the highest given."

Mr. S. E. Barton, of Boston, characterized the report of the National Board of Underwriters, which was quoted in the paper, as the most asinine conglomerate mass of stuff that he had ever read. (Laughter.) The whole basis for the statement made in that report was founded upon the supposition—upon the assumption—that the one great fire in Boston last November was due to electrical causes; and as a matter of fact there was not a shadow of foundation for that assumption. (Applause.) That fire cost the insurance companies something like three and a half or four millions of dollars. It swelled the loss in a certain statistical paper that was published in this country as to fire losses chargeable to electric lighting more than five hundred per cent.; still it was only one fire, only one incident, and that one incident was without any foundation of authority. The number of reported fires which occurred last year from electrical causes was only seventy-three, as compared with one hundred and nineteen the previous year for the whole United States. The number of fires was actually twenty-five or forty per cent. less; but the amount of loss attributed to fires five hundred per cent. greater than last year.

Mr. A. F. Mason, of Boston, remarked that the Association ought to get up a set of rules of its own, independent of the Fire Underwriters', and offered the following resolution to that effect:

Resolved, That the Insurance Committee be instructed to give us independently a set of rules which it recommends, whether they be the same that shall be adopted, or whether they be changed less or more.

Mr. P. H. Alexander said, during the sessions of the Committee on Insurance the Underwriters' representatives were induced to do the best they could for the electric light fraternity. He also quoted Mr. Goddard of Boston: "If you and Mr. Jenks and Mr. Lovejoy say that my rules are wrong I will consider that they are wrong unless I can present an argument and convince you that I am right, because you have had experience in the business which I have not had."

Mr. J. A. Seely then moved, as an amendment to Mr. Mason's motion, that the chair appoint a new committee to formulate rules and regulations governing the installation of electric light, and that the members of that committee shall be active members of this Association.

After a lengthy discussion of the subject by Messrs. Alexander, Duncan, Cutter, Barton and Mason, the whole matter was laid on the table.

Dr. Louis Bell, of New York, then opened the discussion on

THE PROPER CLASSIFICATION OF THE LIGHTING POWER OF INCANDESCENT LAMPS.

I have raised this question for the consideration of the National Electric Light Association because it seemed to me a very curious thing that the whole subject of the classification of electric lights has not been more thoroughly gone into at previous meetings, and that there is now no general accord either in the classification of incandescent lamps as regards their light-giving power, or the methods in which that light-giving power shall be measured. It is rather a singular thing that light should be one of the most difficult things to measure absolutely that we have—not difficult to measure relatively, except in certain cases with which we are unfortunately only too familiar; but it is exceedingly hard to find anything like an absolute standard of light. The last desperate effort in that direction only resulted in perhaps as impracticable a standard as was ever brought before the consideration of scientific men. The question of classifying electric lamps is coming to be rather an interesting one, and one that is of importance to those who supply the lamps. We have various sizes and sorts of incandescent lamp, of all sorts of nominal incandescent candle power, the most usual in this country being the sixteen candle power lamp, but is there any common accord as to what is meant by a sixteen candle power lamp? I think not. And when the matter comes to be tested we find that it is not so. Of the various lamps which are now in use, rated at sixteen candle power nominally, some of them give the full candle power called for by their names, others give ten, twelve, fourteen or fifteen; and some of them give more than the rated candle power, while others give more or less than sixteen candle power, according as to the method of measuring which is used. We do not know at first sight whether it is fair to say that a lamp is sixteen candle power when its mean horizontal intensity reaches that figure, or when its spherical intensity reaches that figure, or when its hemi-spherical intensity reaches that figure. That whole question is open, and certainly ought to come under consideration by this body.

Then again, suppose we take one of those particular candle powers to be the standard; for instance, suppose that we take the horizontal candle power, which is perhaps the easiest to measure. Are we then in any better position? It might seem so at first, but a moment's consideration will show that the size, or rather the shape of the carbon filament has a very important bearing on the distribution of the light, and that consequently a light which gives in any one direction sixteen candle power may give considerably less in any other direction. Again, if we attempt to fix a standard direction, as for instance a direction normal to the plane of the filament for measuring the candle power we again get into trouble, for the reason that while the filament of a circular section gives a nearly equal distribution of light, a rectangular filament necessarily, theoretically and practically, gives an unequal distribution, the maximum intensity being at forty-five degrees off of the plane of the filament, or thereabouts. So that looking at it in any way we like we find that when we are speaking of a sixteen candle power lamp we may, or may not, mean the same thing. With the arc lamp we unfortunately know that the case is even worse, for instead of having an approximately equal intensity throughout a reasonable range around the lamp, we have a maximum intensity in a zone perhaps twenty degrees wide and deflected forty-five degrees below the horizontal plane of the arc.

Furthermore, we know only too well that the nominal candle powers of arc lamps are quite different from the real. The whole subject is in a tangle which at first seems almost hopeless. Heretofore it has not been specially important in the early stages of electric lighting, because people did not look so closely then into the exact conditions under which the light which they purchased shall be given; but as the electric lighting business comes more and more down to close competition and hard commercial lines it becomes more and more necessary to look after these things, and to define just what we mean by the lights which we contract to furnish, and to arrange some way by which there shall be general consent as to the meaning of the terms which we use.

I am happy to say that, as most of you know, the practice abroad tends towards something quite different from the candle power measurement; it tends toward the selling of electric energy by watts even when it is furnished as light—the kilo-watt hour being the British Board of Trade unit; and it is a question which I think we should take up, whether it is not perhaps advisable to classify by watts, a quantity which can be measured with the greatest ease, instead of by candle power, a quantity which is only measured with extreme difficulty. I pass over for the time being the difficulties in actual photometric measurement depending upon the difference in color, as they are subsidiary; but the great question seems to be to find some one definite thing which we can all agree to call a lamp of a certain size, whether it be sixteen candle power, or sixteen watts, or whatever you please to call it. Of course certain objections to the watt classification instantly arise, and among them is the possibility that it may tend to develop a type of lamp which will not be quite as efficient as those which are now generally used. That, of course, is simply a possibility, but it is one of the things that we want to bear in mind, for objectionable as candle power measurement may be, it is not well for us to be blind to the difficulties that come up with any other form of measurement. I desire to bring this subject prominently before the National Electric Light Association, because it is one in which I have felt a great deal of interest, and which I have had occasion to study somewhat, although perhaps more from the scientific side, in the matter of photometry. I believe it is a subject which calls for action on the part of the Association as a body, because I think the time is coming, and is in fact now here, when some such definite standard of measurement is needed and should be had; and this is the only body that has the power to make and to enforce any classification of light which may seem desirable after a consideration of the whole subject. I think that it is a case for action by the Association, and that it should take measures that shall lift us out of the very puzzling difficulty into which we have fallen simply through negligence, and through no fault or intent to deceive, but simply because the whole matter has been allowed to slide, and everybody has gone on in his own particular way instead of having, as we must soon have, something definite, something exact, something perhaps not scientific, but something which shall be at least empirically definite. (Applause).

Mr. A. V. Garratt, of New York—It must be a matter of pleasure to all of us to have this subject brought before this convention. There certainly is no one thing which has caused so much aggravation to the soul of the average electrician as the effort to find some basis on which you can talk about the candle-power of lamps. The trouble with trying to establish in America a practice similar to that of the Board of Trade in London is the fact, which we might as well recognize, that the National Electric Light Association cannot enforce anything. Some years ago I made no less than five hundred thousand figures for this Association to enable it (I was requested so to do) to measure wires. I made enough figures to reach from the city of Boston to the city of Providence. But, after having made those figures, and after they had met the approval of a majority of the members, we found that we were totally incapable of making anybody use them. Now, there certainly can be nothing better—or at least it is the opinion in England, and I think it is of the majority of the men in America—there is certainly nothing better for the unit of incandescent lamps than the kilo watt hour, provided there is proper precaution taken that the makers be not led to turn out a lamp which may possibly not be as efficient as the customer ought to have. Taking the kilo watt hour as the unit of energy for each lamp, and fixing the length of the life of the lamp, would seem to tie up our friends, the lamp makers, pretty tight with regard to what we should call a ten, a sixteen, or a twenty candle power lamp. It is quite impossible to make the purchaser of the lamp, the householder, ever talk about kilo watt hours. They will purchase what they know as a candle power lamp. But this Association might very properly suggest to the manufacturers of the lamps that a sixteen candle-power lamp, or a twenty candle-power lamp should absorb so many watts; and the unit of charge to the customer might be based upon watts as against hours. That might perhaps be best brought before us in proper form by the action of a small committee who could bring the subject before the next meeting of this Association in a paper, and if it is satisfactory to the body it might then be recommended to the lamp manufacturers. It is a thing which I do not think the general public will do very much with; and I do not see that it is a thing which the National Association can very well enforce. But I am positive that the kilo-watt hour would meet the approval of all the electric light fraternity in the country.

Mr. Alexander—The efficiency of the lamp to the consumer is of the greatest value only in some cases. If I have a water-power to run my central station, as the power does not amount to anything, I do not want an efficient lamp, but I want a long-lived lamp; but when I use coal at five dollars per ton I want a very efficient lamp. It is a fact that I have had from one railroad company a letter in which they ask me for a very inefficient lamp, because it costs them more to move their storage battery in and out of the car than the breakage of the lamps amounts to. They have by figures furnished by their electrician shown that a very short-lived lamp, say a lamp that lasts them but one-hundred hours, is cheaper than one which lasts them six hundred hours but needs a great deal of current.

Dr. Bell—The question of arc lamps I felt tempted not to touch upon for the reason that we have not been in the habit of measuring those anywhere in the world by the watt. The incandescent lamp is supplied frequently by meter, and that is what brings the matter of classification into special importance. We all know very well that the arc lamp is a great sinner in the matter of the distribution of light, and in the difference between theoretical and practical efficiency; but at the same time we ordinarily do not measure the power supplied to arc lamps in watts, as is getting to be somewhat the custom as to incandescent lamps. I should certainly be in favor of including the arc lamp in any action which the Association might take on this question.

The President—In making a test of the lamps of six different makers, I found that the variation in sixteen candle-power incandescent lamps is much more extreme than would be called a fair ordinary commercial average. I found that in two lamps the variation was from 17.25 candles to as low as 6.42 candles; and the watts per candle varied from 3.18 to 8.2. They were all new lamps.

Mr. Alexander—That is a subject that I am interested in; and I want to say that a lamp that will measure at the start twelve or thirteen candle power, after two hundred hours will likely give more light than a lamp which measures seventeen candle power at the start. All these matters have to be considered. If I desired to measure and to make an actual test I would measure the lamp after 50 hours burning, and then I would get a good result.

The President—We are now going through with tests and measuring every twenty-five hours. I will say, however, that a lamp which gave 17.25 candles was the lamp which at the end of 1,000 hours showed the least blackening of any lamp we had, but unfortunately it was not as efficient as I would like to have them.

Mr. Garratt then moved that the President be instructed to appoint a committee who shall report at the next meeting of the Convention on the proper classification of the lighting power of incandescent lamps. The motion was carried.

After a few announcements regarding social events the meeting adjourned.

THIRD SESSION, WEDNESDAY, AUG. 20.

The Association met pursuant to adjournment, Wednesday, August 20th, 1890, at 10 A. M.

The President—The first matter to be considered this morning in the order of business is the report of the Committee on Patent Legislation, of which Mr. Arthur Steuart is chairman.

Mr. Wilmerding—There does not seem to be any member of the committee here, and I move that the committee be discharged. They have not made a report for two or three meetings, as I understand, and I think we might as well give it up.

The motion was carried.

The President—Next is the report of the Committee on Legislation, Mr. C. H. Wilmerding, chairman.

Mr. Wilmerding read the following report:—

REPORT OF THE NATIONAL COMMITTEE ON LEGISLATION, TWELFTH CONVENTION.

Members of the Committee. Allen R. Foote, Chairman.

1.	Alabama	
2.	Arkansas	
3.	California	George H. Roe.
4.	Colorado	C. H. Smith.
5.	Connecticut	John C. English.
6.	Delaware	
7.	District of Columbia	George C. Maynard.
8.	Florida	
9.	Georgia	H. E. W. Palmer.
10.	Illinois	C. H. Wilmerding.
11.	Indiana	John Caven.
12.	Iowa	
13.	Kansas	L. A. Beebe.
14.	Kentucky	A. H. Barret.
15.	Louisiana	
16.	Maine	William R. Wood.
17.	Maryland	J. F. Morrison.

18. Massachussets............F. A. Gilbert.
19. Michigan.................J. E. Lockwood.
20. Minnesota...............
21. Mississippi...............
22. Missouri.................Joseph A. Corby.
23. Montana................
24. Nebraska...............
25. Nevada..................
26. New Hampshire............Alonzo Elliott.
27. New Jersey...............Henry W. Pope.
28. New York.................E. A. Maher.
29. North Carolina............D. A. Tompkins.
30. North Dakota ....Vincent S. Stone.
31. Ohio.....................Charles R. Faben, Jr.
32. Oregon...................P. F. Morey.
33. Pennsylvania..............A. J. DeCamp.
34. Rhode Island..............Marsden J. Perry.
35. South Carolina............George B. Edwards.
36. South Dakota.............
37. Tennessee ....
38. Texas....................
39. Vermont..................M. J. Francisco.
40. Virginia.................
41. West Virginia ....John B. Carden.
42. Wisconsin.................S. S. Badger.
43. Washington...............

1. At the Eleventh Convention this committee was instructed to "report for the action of the next convention, such changes in the Constitution as will in its opinion best provide for the membership and representation of State Associations in the National Association. (Volume VIII., page 249.)

After this action had been taken, the convention raised a special committee charged with the duty of making a general revision of the Constitution of this Association. In view of this, this committee has considered itself discharged from further consideration of the subject.

2. By action of the Eleventh Convention, this committee was instructed "to co-operate with the New York State Association in securing such an amendment to the Execution Law of that State as to require a special apparatus to be devised for the purpose, that shall generate a current of not less than 10,000 volts." (Volume VIII., page 248.)

No request has been received from the New York State Association for such co-operation, and so far as this committee is informed, no effort was made during the last session of the Legislature of that State to so amend the law. In the light of the reports made regarding the experimental execution that has since taken place in that State, it is now probably as clear to the public as it has been to this committee, that if executions are to be made by the use of electric currents, the amendment to the execution law recommended by this Association at its Eleventh Convention is demanded by every humane and equitable consideration.

(*a*) To give practical effect to the "Memorial and Statement," presented to Congress in the name of this Association by its president, which was presented in the United States Senate by Senator Hale, on August 5th, and was referred to the Committee on the Census, and ordered printed:—A Member of this Committee has prepared a bill which was introduced in the Senate of the United States, August 15th, by Senator Hale. It was read twice and referred to the Committee on the Census.

Your Committee recommend that the Association endorse this bill and urge its enactment, and that a resolution of thanks be tendered Senator Hale for his courteous and prompt actions regarding this subject.

This bill is as follows:—

51st Congress.
1st Session. S. 4,329.

In the Senate of the United States.

August 15, 1890.

Mr. Hale (by request) introduced the following bill, which was read twice and referred to the Committee on Census.

A Bill

To amend an act entitled "An act to provide for taking the eleventh and subsequent censuses" approved March first, eighteen hundred and eighty-nine.

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, That, for the purpose of rendering the investigation of the electrical industries by the eleventh census thorough and complete in every detail, the Superintendent of Census, under the direction of the Secretary of the Interior, is hereby authorized and directed to make such subdivisions of the subject as may seem to him advisable, and to associate with the special agent now commissioned to investigate the manufacture of electrical apparatus and supplies and their uses, as special expert, the ablest person whose services can be secured to write the statement for each subdivision so made, subject to the supervision of said special agent; and the sum of fifty thousand dollars, or so much thereof as may be necessary, is hereby appropriated, out of any money in the Treasury not otherwise appropriated.

3. During the legislative season of 1889-1890, comparatively few State Legislatures were in session. During the coming legislative season, 1890-1891, a large number of State Legislatures will be in session.

If legislation touching electrical interests proves as attractive to the coming legislatures as it was to those that have recently been in session, there will exist an exciting cause sufficiently urgent to fuse all central station companies in every state into a compact organization for the protection of their mutual interests.

That ill-advised legislation will be met with in every state admits of no doubt. So long as would-be law-creators think it a factor of popularity to show in their legislative records that they introduce bills or advocated measures that are intended to be, or are in fact, antagonistic to the practical development of the electrical industries, such things will be done; or, so long as persons interested in patented apparatus and systems think they can gain a commercial advantage for such interests through legislative enactments, they will seek to secure such enactments regardless of their effect on electrical interests in general.

4. That those interested in the electrical industries in each State will be thoroughly organized and equipped to meet the emergencies that will be thrust upon them is very much in doubt. There is no sense of security equal to ignorance of danger. For those who are ignorant of a danger it has no existence. This, we fear, is the condition of most central station companies in this country regarding impending dangers from legislation. In view of this, the greatest service that may now be performed is to so state the threatening dangers that they can no longer remain in ignorance of them. To do this there is no need to speak of unreal things that are but creations of imagination. Sufficient material for the purpose is found in the record of things that are.

5. To show the tendency and animus of thought of those intrusted with the responsibility of legislating for the good of the people, a critical analysis is asked for the following brief reports on the work done by the legislatures of a number of States during the last season:

6. Connecticut.

(Senate Bill No. 4.) Chapter IX.

An Act relating to Attachments and Judgment Liens.

7. Massachusetts.

No better presentation can be made of the subject for the State of Massachusetts than to present in full the Report of the Counsel of Massachusetts Electric Lighting Association, made at its first annual meeting under date of July 8, 1890.

(Report was appended.)

8. New Jersey.

February 12, 1890, a substitute for "Assembly 113" was introduced "by Committee on Municipal Corporations." "An Act relating to electric telephone and telegraph wires and creating boards of electrical control in cities of the first and second class."

February 14, 1890, Assembly No. 6. Introduced by Mr. Smith and referred to Committee on Corporations:

"An Act in relation to telegraph, telephonic and electric companies in cities of this State."

Copies of these bills were in appendix.

9. New York.

January 21, 1890. In Assembly No. 160. Introduced by Mr. Whipple, read once and referred to the Committee on Ways and Means:

"An Act to create a board of electrical commissioners and to define and regulate its powers and duties."

February 20, 1890. In Assembly No. 598. Introduced by Mr. J. H. Stevens (by request), read once and referred to the Committee on Electricity, Gas and Water Supply:

"An Act authorizing water companies to manufacture and use electricity for the lighting of streets, public places and private buildings in cities, villages and towns within this State."

February 21, 1890. In Assembly No. 629. Introduced by Mr. Whipple, read once and referred to the Committee on Electricity, Gas and Water Supply:

"An Act to protect life and prevent accidents in the use of high tension electric currents."

April 4, 1890. In Assembly No. 1387. Introduced by Mr. Molan, read once and referred to the Committee on Electricity, Gas and Water Supply:

"An Act to create a State board of commissioners of electrical control and to define and regulate its powers and duties."

April 18, 1890. In Senate No. 618. Introduced by Mr. Erwin, read twice and by unanimous consent ordered printed, and when printed committed to the Committee on General Laws:

"An Act to create a board of electrical commissioners and to define and regulate its powers and duties."

April 18, 1890. In Senate No. 634. Introduced by Mr. Erwin, read twice and by unanimous consent ordered printed, and when printed to be committed to the Committee on General Laws; report favorably from said Committee, with amendments, and committed to the Committee of the Whole:

"An Act to create a State board of electrical control and to define and regulate its powers and duties."

(For copies of these bills see appendix.)

In transmitting copies of these bills to the Chairman of this Committee, J. W. Eaton, Jr., attorney, of Albany, N. Y., writes as follows:

"None of these bills have become laws. I am of the opinion that an attempt will be made next year to rush through the legislature a bill combining most of the principal features of those sent you unless some determined opposition develops in the meantime. I believe there is also a movement in favor of adding an electrical expert to the present railroad commission and putting the matter under their charge. There was no law of general interest affecting electrical lighting passed this session."

10. Ohio.

The legislature of this State was urged to action by the following highly electrified paragraph in the Inaugural Address of Governor Campbell: (See reports in daily press, January 13, 1890.)

"The application of electricity is rapidly opening up new fields of legislation. Unless something be done to prevent the sacrifice of life daily resulting from the effect of electrical wires, the companies which put up and control them will have grown so rich and powerful that the passage and enforcement of proper laws will be difficult. Municipalities have attempted to enforce regulations for protection from such dangers, but without satisfactory results. The duty of investigating the generation and distribution of electrical currents is one which presses upon you. The investigation should be prompt and thorough; the result thereof made public; and such action taken as may, in your judgment, throttle this evil in its infancy."

The following bills were introduced into the Ohio legislature at the last session:

"A Bill concerning electric wires and circuits dangerous to life and property."

"A Bill to authorize the construction of subways and underground conduits in which to place electric wire cables and other electrical conductors in cities, towns and villages of this State."

"A Bill to regulate electric light companies so as to protect the public from accident and damage from the same."

"A Bill relating to electrical conductors for electric lighting in cities of the first grade of the first class, and the removal of overhead wires."

11. Virginia.

Senate Bill No. 238. A Bill for the prevention of danger from electric currents. Patron—Mr. Lovenstein. Referred to the Committee on General Laws.

12. While this report does not completely cover the ground, owing to difficulty experienced by this Committee in obtaining copies of bills and definite information regarding action taken on them, the showing is sufficient to demand attention from every one interested in the electrical industries, and will enable them to form some idea of the legislative work that is near at hand during the season of 1890-1891, when the legislatures of some thirty-seven States will be in session.

13. This Committee desires to call attention to the fact that all legislation is directed to the regulation of the use of electrical apparatus, not to its manufacture and sale. This use includes all forms of apparatus, the telegraph and telephone, as well as the generation and transmission of electric currents for light and power. Such legislation affects primarily the interests of those who have their capital invested in plants for furnishing such service and thus establishes a community of interest between them. The interests of manufacturing companies and supply houses in such legislation is secondary, as they are only affected through the effect on operating companies. For these reasons, and in view of the fact that legislation is confined to State legislatures, there is a real necessity for the operating companies in every State to form themselves into associations for the development and protection of their mutual interests.

14. In analyzing the subjects of legislation, this Committee would be untrue to the interests it represents should it fail to bring to notice the fact that most of the so-called antagonistic legislation is not the result of a popular demand, but issues from those interests that seek a commercial advantage by legislation that, either directly or by implication, would create conditions favorable to their particular apparatus or systems. A diminution of efforts of this kind may be reasonably expected, as the art of generating, distributing and using electric currents becomes more and more a matter of common information and electrical systems approach more nearly to the zenith of their development.

The President—The Committee on Legislation have in their possession, and it will be transferred to the secretary to be incorporated in the volume of proceedings of the convention, all of the bills, in full, referred to in that paper, and of course they will be at the service of the central station men; and I have no doubt they will prove very valuable indeed as showing the general trend of the legislatures throughout the country.

I learned with much pleasure this morning of the presence here among us of the first man who ever occupied the chair of the National Electric Light Association; and, without consulting the convention, I shall venture to appoint two gentlemen to escort him to the platform; and I think we shall all be very glad indeed to hear a few remarks from him. The chair will appoint Vice-President Edgar and Mr. DeCamp as such Committee.

(Mr. Edgar and Mr. DeCamp escorted Mr. George S. Bowen to the platform.)

The President—Gentlemen, I have great pleasure in introducing to you Mr. Bowen, one of the early fathers, who has now come to take a look at his child. (Applause.)

Mr. Bowen—Mr. President and Gentlemen of the Electric Light Association: You certainly have placed me under great obligation by the graceful compliment which you have conferred upon me in asking me to stand before you and look at the child that was born some six years ago. It is true, as the chairman has stated, that I called a convention to order in Chicago, and I did it after some weeks of labor in sending out circulars, etc., inviting the men who were engaged in the electric lighting business to get together, to become acquainted, to rub together slightly and see what the effect might be. My own opinion was that it would be useful to us all, and to that end we created a little committee in Chicago, and I was made the chairman of it, and I had the honor of sending out those circulars, and in responding to the circulars there were about one hundred and fifty gentlemen who came from all quarters of the Union to Chicago. I mention, as I stand before you, an incident which occurred, which often has come to my mind, and it was this: Mr. Morrison, of Baltimore, said to me, on being acquainted, "What are your plans?" I said, "Well, we have no underground plans or overhead plans. My plan has been simply this, to invite the electric light men to come together, to become acquainted with each other, and after I have called the convention to order and you are all in the room which has been provided for you, my duty is done. I have no plan at all, because I have the utmost confidence in the capacity of the men that have taken hold of this great business, the lighting of the world, to take care of themselves, and so I have made no plan whatever." (Applause.) And so you see, gentlemen, that it gives me the greatest pleasure in seeing the growth and the activity and the real benefits that have come to the country from this organization of the electric light fraternity. I cannot go anywhere scarcely, it may be the most remote town—and I have been all over this country and a good deal over Europe during the last year, and I say to you that America to my mind seems to be ahead of Europe in the electric lighting business; and so what shall we finally come to? I do not make any prediction, but I say to you, gentlemen, you have only opened the first page. I expect to live to see the day when all these little towns all over the country shall be illuminated with electric light, and we shall have not to grope about in darkness as much as we have heretofore; because some of you gentlemen are going to develop plans by which all the world may have the light at an expense so nominal that they cannot afford to be in darkness; and so the world will be indebted to the electric light men for all of that.

Mr. Weeks—Mr. President, on behalf of the Executive Committee, I would report to the Convention their recommendation that Mr. George S. Bowen, who has just addressed the convention, and to whom more than to any one else this Association owes its existence, be elected an honorary member of this Association.

The motion was duly seconded and carried.

Mr. Bowen—Mr. President and gentlemen, you have placed me under still renewed and lasting obligation. I assure you that I appreciate this delicate and beautiful compliment to me in all its best phases, and so I only wish you the very best that God Almighty can give to you all through your lives. (Applause).

The President—We will now resume the regular order of business and proceed to the consideration of the report of the National Committee on Legislation.

Mr. Mason—Mr. President, I notice that this report now under consideration, and recently read by Mr. Wilmerding, refers to a bill that is now in the Committee on the Census, the Committee of the Senate. I beg to offer the following preamble and resolutions:

Whereas, On the 15th of August, 1890, the honorable Senator Eugene Hale, introduced in the Senate of the United States a bill to amend an act entitled an Act to Provide for the Taking of the Eleventh and Subsequent Censuses, approved March 1, 1889, and

Whereas, The said bill was read twice and referred to the Committee on the Census, and

Whereas, In the opinion of the National Electric Light Association, the passage of this bill is essential to render the investigation of the electrical industries by the Eleventh Census thorough and complete; therefore,

Resolved, That the President of this Association be requested to express this, our opinion, to the Committee on the Census and urge the Committee to favorably report to the Senate the bill referred to.

Resolved, That the thanks of this Association be tendered to Senator Hale for his services in the matter of the bill above referred to.

The President—Gentlemen, you have heard the preambles and resolutions offered by Mr. Mason. What is your pleasure?

MR. DECAMP—I move they be adopted.

The motion was duly seconded and carried.

THE PRESIDENT—Are there any remarks on the same question? If not we will now listen to the paper on Municipal Lighting, by M. J. Francisco, of Rutland, Vermont.

Mr. Francisco read the paper. See page 210.

THE PRESIDENT—The Chair will announce the appointment of the Committee of three on the proper classification of the lighting power of incandescent lamps: A. V. Garratt, Louis Bell, P. H. Alexander.

The paper which has just been read is now open for discussion. Are there any remarks on the paper just presented by Mr. Francisco?

MR. WILMERDING—I move a vote of thanks to Mr. Francisco for the able way in which he has set forth this matter. I hope that the paper will have a circulation all over the country, and do some good; and I think that the Association ought to thank Mr. Francisco for the labor and care that he has taken in preparing this valuable paper.

MR. DECAMP—I think that the most lasting compliment which can be paid to the author of that paper will be for this Association to authorize its printing for general distribution among the members, so that they may all have an opportunity of making direct use of it. I do not think that a paper of that kind should pass without very general remark by this Convention upon it. Personally, I do not feel competent to do it, because I have not been touched as yet in that direction. I would probably be a little more lively at the present time if I had been. But, in listening to the paper these things struck me. It is known to every man on the floor of this convention who is engaged in the business of electric lighting, that municipal ownership of electric light plants has its origin among a few politicians who wish to add another plum to the public pudding that they may pluck it. There is no question about that. There is no sentiment in it; it is a simple matter of fact. The public who have to pay for this know nothing else, excepting, perhaps, the two or three points which the public know fully as well as their servants in these matters; and one of them is the fact that there are certain things in connection with municipal management that are always notably extravagant. There is one point that might well go forth in some shape, and which would wake the people up a little who have the final decision of these matters. I suppose that it is pretty nearly a correct statement that from fifty to sixty per cent. of the total cost of producing electric light is in the labor account alone. It is one of the most difficult problems that electric light companies have to contend with. It is something that is the hardest to control. Now, if there is anything under God's Heaven in which there is extravagance practiced by municipal governments it is the matter of labor. For a municipal government it invariably takes two men to do one man's work. They are as a rule extraordinarily extravagant in the matter of labor, to say nothing of the other elements of political patronage which enter into it. But I would like to see this report printed, and I would like to have copies for free distribution among the members. I will pay for it if it cannot be done in any other way.

JUDGE ARMSTRONG—I feel myself very much obliged to Mr. Francisco for this paper. The instances he cites were used as against our company about a month ago when we made our annual bid for lighting our city. It so happened that our general manager had the answer ready to the most of these criticisms, and yet a new member of the City Council, flushed with his victory at the polls, and believing that the eyes of the whole community were upon him, and that upon his shoulders rested the protection of the tax payers against a grasping monopoly that had the lighting of the streets, went into the City Council and claimed that our bid for lighting the city was entirely too high, and that Bay City, Bangor, Dunkirk, and all the rest were having the lighting done at so much less. The answer to all those criticisms was made in such a manner that nothing further could be said. But how much better we could have answered it had we just this paper to hand to every member of the City Council, so that we could say to them, there is the author's name; there are the facts; now say what you please concerning it. There was one thing further—and possibly an opportunity will come to speak of that later—which we cannot so well answer. There were parties who desire to sell one or two dynamos to other companies that inspired other bids. We may be able to speak of that after a while under another subject. I want to endorse very heartily Mr. De Camp's suggestion that we have this printed by the Association for distribution throughout all of the cities where electric light is furnished by private corporations; and the facts contained in this paper will do much in the creation of a proper feeling, a kindly feeling from the taxpayers and citizens towards our companies; and when we shall have accomplished that, I think we shall have done a great good in the way of making popular our work, and in the way of enlightening the people, and where we expect to get our returns, and what we furnish for it, and how we furnish it.

MR. BARRETT—I notice, in looking over the account here, that I am asked, or the city electrician is asked, some very pertinent questions. I do not advocate the absorption of a commercial business by any municipality. I never did. The city of Chicago's electrician has simply performed the orders which he received. This statement strikes me as rather a singular thing. I find here that the cost of municipal lighting is set forth very clearly, very extensively and very expensively; but I have never, in all my experience with this Association, seen a tabulated statement of what it costs to light a commercial plant, per light—never in all my life. Now, this is what strikes me as being rather singular: Why cannot a city light its streets as cheaply as a commercial company can? Isn't the market open to the city to purchase its material? Can't it hire its laborers as cheaply as anybody else? Has it not an officer, and is he not compelled to report expenditures just as clearly and distinctly as does the head of any private concern? Why should it cost the city more than it does anybody else? I have charge of the municipal electrical service of police, fire, board of health, and the city lighting. I get economy as to materials. I do not claim that I can light a lamp any cheaper than anybody else. I do not claim that it costs me any more than it does anybody else to light a lamp, except in labor alone. We do have to pay more for labor than anybody else. If I could get this lighting from corporations for what it costs us to maintain our own lights I assure you, gentlemen, that I would recommend it.

MR. GARRATT—It seems to me that the simplest reply which can be made to the question why, or why shall not, a city do its own lighting, will be found right in the words of President Cleveland on the tariff question, when he said: "In this matter we are dealing with a condition of things and not with a theory." If we were dealing with a theory, there is absolutely no reason why a municipality cannot do any business that any citizens are engaged in more profitably than the individual citizens can do it themselves. We are dealing with a condition of things which, in the United States, under our form of government, is this: That the government shall not in any way interfere with the rights and privileges, the pursuit of happiness and the success of its citizens; that the citizens themselves shall do the industries of the country; that the government shall be as small and as insignificant as is possible to hold people together in a civilized community. That is the simple question. Theoretically speaking, I see no reason why a municipality cannot bake the bread for the people, or why it cannot butcher the beeves. There is no reason why, except that in the condition of things under which we are living it is entirely unfeasible.

MR. DE CAMP—I think Mr. Barrett put the true question when he said, "Why can't it be done?" Well, there ought not to be anybody more competent to answer that question than Prof. Barrett himself, because he is right in the business; but he don't do it. Now, in reply to the other point, in which he says that no commercial plant has come forth to say what their lights have cost them. There is a plain answer to that. That has not yet become necessary, and it is not customary, except by the lowest bidder. Now, the figures which Prof. Barrett has named and set forth and published broadcast over the world, have been so much lower than any commercial company has ever produced their lights for, under anything like similar circumstances, that that thing is not at all necessary. A commercial company who have stockholders to serve, and who are under certain confidential obligations, which are generally recognized, are not in the habit of publishing that sort of statement. So that I presume when the commercial lighting comes down to a point where they can produce the lights at a less cost than the municipal plants are now costing, we shall hear just what they cost; and they can very well afford to wait until that time.

MR. DUNCAN—Judge Armstrong has hit the case fairly well when he stated the case of the representative of the municipal body who lacked information. I am not here to defend municipal bodies. I know something about the manner in which municipalities are conducted. While my friend De Camp thinks that every man who has ever had any connection with a municipal body must naturally become dishonest, I differ with him. (Laughter.) I believe that the same percentage of honesty will prevail in municipalities as in the Electric Light Association. But, sir, the information that the gentleman from New Jersey had to put before his man was meagre. What we want to do at the present time is to place the statistical information, which has been prepared by Mr. Francisco with a great deal of labor and care, in such shape that members of this Association can use it when this question arises in their cities or towns. I do not blame that man in the New Jersey town as much as I do the Judge. I think it was his duty, as he was the most interested party of the two, to obtain this information at any cost. We are to day all on the same platform and we are going to use this information where it will do some good. I hope the resolution will pass.

MR. DE CAMP—Mr. Chairman, I have got a question here for Prof. Barrett, but he seems to have left the room. The question is, whether, in the published statement that the Chicago lamps cost sixteen cents per light, he includes interest on investment, his salary and depreciation.

MR. FRANCISCO—I can answer that for Mr. Barrett. I have a letter from Prof. Barrett in which he states point blank that he does not include it.

THE PRESIDENT—I think the question is answered.

MR. HAMMER—I have a suggestion which I think is very pertinent to this subject, which comes from across the water. I lived in the city of Paris last year and I became acquainted with some of the gentlemen connected with the municipal government there, and among them the chief engineer of the city, who had charge of the municipal lighting affairs, and I learned some things which have considerable interest as bearing directly on this subject. The city of Paris some time ago offered a prize for the best electric meter that was brought to their attention. Tests were conducted, and there is to be, I believe, a second series of tests. It may also be known by many of the gentlemen here that the city of Paris, at a very considerable expense, has placed in one of the sections of Paris a large plant on the direct current system, and also a large plant on the alternating system. The city of Paris, a great many people have supposed, was going into municipal lighting, and that these experiments were intended as leading up to the city of Paris putting in enormous central stations for doing the general lighting of the city. I asked the engineer if he would give me an expression of his opinion of just the status of the government in regard to this matter, and he said it was this: That the municipality of Paris appreciated that electric lighting had come to stay, and it was an enormous industry, one of great importance to them, and one in which the French people were backward in taking hold and pushing forward; and that they desired, as has always been characteristic of the French people, to encourage the arts and sciences, and in this particular case they wanted to encourage this industry. With that end in view they took a representative direct current system and a representative alternating current system and placed them in one of the sections of the city and said: "Now when we are through with the test, the system which has given us the greatest satisfaction, and which we can endorse as being the best for the city of Paris, will be applied, and the municipal lighting will be done by that system." And I asked him about the relation of the meter tests, and he said they were very similar; he said the meters were to be tested, prizes awarded, and the city of Paris would retain the privilege of utilizing any meter which they decided upon as being the best, but that that utilization would be only very limited, to be used in these experimental stations, and that the city of Paris did not propose to go into the manufacture of electric light any more than they were going into the manufacture of any other commodity; that they did it entirely to foster the industry. (Applause.)

THE PRESIDENT—Mr. De Camp, Prof. Barrett has now returned to the room, and you will now have an opportunity to ask him the question.

MR. DE CAMP—Mr. Francisco answered the question that I asked, whether the published statement of the cost of sixteen cents per night per lamp included interest, his own salary and depreciation.

MR. BARRETT—It don't include interest; it don't include water taxes, rent—or, yes, it includes depreciation. We don't have any depreciation. (Laughter.) We buy a class of goods that will last. I will say that sixty-two miles of wire last year cost me $16 for maintenance—underground.

MR. DE CAMP—How many lamps did you have on?

MR. BARRETT—I don't know.

MR. DE CAMP—That is a very important factor.

MR. BARRETT—I will not attempt to answer it; I don't know. I don't know the amount of wire that we have in that district. But there is another consideration that I want to mention and that is this: That by the action of the council the gas and the oil and the electric light is one fund, and the electrician has charge of all, and of course it would cost less. I have endeavored to be honest with you, gentlemen, and I have endeavored to get an honest expression. (Applause.)

MR. ALEXANDER—Mr. President, it seems to me Prof. Barrett is right in so far that when the municipality makes an appropriation and comes within that appropriation, or goes outside of it, the proper office states, "We have expended in this department so much money." Now in the Fire Department you are never asked whether you are to have the apparatus capitalized, or the buildings capitalized, but you say, "Our Fire Department cost us this year $7,445." Why should you make a difference as a municipal officer in that particular branch? These are reports that are published. Central station men want naturally to give the stockholders of their companies a complete statement, not as to what the lights cost, but as to how much money they have made or lost during the year, while the municipality from year to year have new appropriations made, and old apparatus is replaced by new appropriations.

MR. BARRETT—The only report that I make is the gas and oil. I show the comparative cost between gas and electric light and oil—always in favor of electric light.

MR. T. C. SMITH—There is one point on this question that I think we should look at fairly. There is no doubt that a municipality under certain conditions can, and under all conditions ought to be able to, run its plant cheaper than any corporation. On the other hand, I think there is very little doubt that it very seldom does. The remark that Mr. Garratt made about dealing with conditions and not theories I think is a very pertinent one; and I think if you will examine into the administration of a good many of the larger European cities you will find that a good many of those cities do own their own gas works and water works and do furnish gas and water as cheaply as a corporation would; but on the other hand, you will find a very large number of cities, and especially the very large ones, who do not own the gas works or water works, and yet water and gas are supplied at a far less rate than when the cities do own them. Another thing you have to take into consideration is what is meant when you speak of the cost of running gas works in the city, or an electric light plant. In Philadelphia they have a good chance to supply gas as cheap as anybody. Their gas plant lies by the water; they can get cheap transportation for coal; they have an excellent market for coke and all waste products, and they charge $1.50 for about the meanest gas I ever saw. Not only that, but the city pays $150,000 for gasoline lamps. I think that $150,000 should be charged right into the gas works, for the city is supposed to do its lighting and yet it pays an outside corporation that money. I think there are a good many things that we want to look at very carefully, and the more this thing is probed the more baseless you will find the claim to be that the city does run the lights cheaper; and I think Mr. Francisco's paper ought to be published as widely as possible, because when you go into any average Council Chamber and listen to the talk you will find very soon that it is not facts that are taken into consideration but talk; and if you have good solid facts that you can put to these people that can not be controverted, it will have more weight with the public than anything else. I have seen these statements of the cost of lights in the various cities, that have been sent around, and some of them are very wonderful, as Mr. Francisco has shown them to be.

MR. DECAMP—Mr. President, I wish to make a statement of fact. The city of Philadelphia has owned its gas works for a great many years. In the annual statement of the Board of Gas Trustees they always showed an enormous profit; but under the new charter it was taken out of the hands of the Board of Trustees, and for all moral purposes it is generally conceded for the better. It is a matter of history that the gas trust in Philadelphia was one of the greatest sinks of corruption in the whole city, and on moral grounds, if on no other, it was taken from the Board of Trustees and placed in the Department of Public Works, which in point of honesty has the confidence of the whole community, unpopular as it may be personally. They found that the capacity of the present established plant was not sufficient to supply the needs of the city for public purposes, and for private purposes too —because they furnish light to private parties. There was no money to build additional plant. The next thing was to contract with a new company for the furnishing of three million feet of gas a day to make up the deficiency. They contract for that at 37½ cents per thousand feet delivered in the holder. They sell it for $1.50 a thousand, and according to the official report published for last year, show a profit—I don't know just what the amount is, but if they had not had the profit on these three million feet a day of the difference between 37½ cents and $1.50 which they sold it for, with all the increased effort and with the prestige of an honest, business-like administration of those affairs, the gas department of the city of Philadelphia would have shown a very heavy loss for the year 1889, even with gas at $1.50 a thousand.

MR. ALEXANDER—I do not believe in municipal plants, but I hope the statements that are made here to go out as printed will be fair to all parties. 37½ cents is the price of gas in the holder —the gentleman did not say that is not including the cost of distribution and leakage in the pipes, which will diminish the profits of the city of Philadelphia on that three million feet considerably.

MR. DUNCAN—He said in the holder.

MR. DECAMP—Mr. Alexander calls attention to the fact that there is the cost of distribution.

MR. ALEXANDER—Distribution and leakage in pipes.

MR. DECAMP—I know that. I will call that part of the statement back. I am not certain about it.

MR. T. C. SMITH—The city pays for delivery into the holder, but the gas is distributed in exactly the same service; there is no additional service laid down. You have the cost of distribution in the same pipes.

MR. FABEN—An analysis of the statements that they made shows that if their business was self-sustaining before this three million was added, the buying of this three million feet at 37½ cents and selling it at $1.50 ought to give them a profit of the difference between those two prices; but they did not realize the difference between the cost of three million feet at 37½ cents and the sale at $1.50, which would show that their business before they bought this three million feet at 37½ cents was not self-sustaining.

MR. ALEXANDER—That is exactly what I am getting at, that the difference between 37½ cents and $1.50, is not the profit, but they realized a profit beyond the cost of distribution.

MR. DUNCAN—I should like to ask one question of this committee. While this is a very gratifying report, it does not seem exactly fair that we should make a statement in regard to a company which is furnishing lights to a city, on a bid, unless we ask whether they take into account or not their other business in connection with it; whether they make a separate item of that alone, as run as a separate business, which the municipality does. You

have got to get them on the same basis to make a fair statement. Did the Committee on Data get any information of that kind?

THE PRESIDENT—This is not the report of the Committee on Data that is under consideration.

MR. DUNCAN—The committee need not answer it now.

MR. DE CAMP—It is a pertinent question to come in here. I have always felt perfectly safe in making these statements, because whatever doubt there was in it was on the other side. I do not, as far as I am concerned—nor am I able, and I do not see how I could do it—eliminate it and get the fixed cost of the special city service as distinct from our general service; but if you take it on the hour basis you can make a very safe approximation. The city lighting in the city of Philadelphia, I think, averages about eleven hours and some few minutes, ten to twelve minutes. Now the general average of the whole business, including commercial, is practically the same thing, eleven hours. But a large portion of the commercial business, if you took the commercial business by itself, would not average probably more than six hours. Now if you eliminate that you have got the advantage of the short hour service in commercial business, and if you were to eliminate all commercial business and take city business, whatever difference there is would be against the city, because you would have nothing to offset in the way of short hours. I am perfectly safe in saying that our general average is a fair one when you are discussing the matter of municipal lighting.

THE PRESIDENT—Unless there are some further remarks, Mr. Bowen will close the discussion.

MR. BOWEN—I have listened to the discussion with a great deal of interest, having had something to do with city lighting myself, and I rise especially for the purpose of approving and commending the suggestion of our friend from Philadelphia, Mr. DeCamp, who advises the publication of this paper for general free distribution. I know of nothing that will dispel so much darkness as light; and this paper throws a good deal of light upon this subject; and I should recommend and should be quite willing to pay my proportion for the publication of ten or twenty thousand copies of that paper, that it might be distributed very generally all over the country; and I am quite sure that if that paper were sent to a great many towns in the United States, to aldermen perhaps, or the mayor, or some of the principal persons there, it would create a disposition to look into the subject of electric lighting and see if they could not improve and benefit the town by a better system of illumination; and I am quite sure that that would be one of the very best advertising documents that electric light men could send out. Although I am out of the electric lighting field now, I extend my cordial sympathy to all of the gentlemen who are in the electric lighting business who are furnishing cities with light and have to deal with city councils. Criticisms are frequently made; I have been the subject myself of newspaper criticism to such an extent and to such a degree that I have been almost immortalized in my own locality as the great coupon clipper of an electric lighting company that made its lights without any cost. In fact, I have been charged with producing electric light without the consumption of any coal. The information which is conveyed in this paper will be very useful and will produce a great deal of excellent thought, and you will get good results from it. In this statement regarding the lighting of the city of Dunkirk, it is said that after using their machinery for a year and eight months their lines are in a better and more perfect condition than when they first started. That differs from what my experience was, because about the first year after I put in my plant I had to build it all over again, and I have heard of others that had to do the same thing; and that is why I suggest to you that whenever you do a thing do it well. On that point I want to say one thing. Prof. Barrett enjoys the confidence of every man in Chicago, whether he is a democrat or a republican. They all refer to him as an absolute authority, and he has full power to carry on the electric light business and his bills are paid. There is the great advantage that he possesses. I happen to know of a city where a while ago they wanted a few brushes, and they sent the city clerk to the nearest seaport town, and that happened to be Chicago, to buy a couple of pair of brushes. That cost the city some fares, etc., and gave the man a chance to go to Chicago. There cannot be a thing done unless a committee passes upon it. If a man wants to sell a few carbons they call the committee together; and all of you know who have had anything to do with selling carbons, what you have to do when you meet a committee. (Laughter.) All those things can be avoided by having absolute authority, as Mr. Barrett has. I congratulate him, and I congratulate the city because he is a man of great capacity as an electrician, and is an honest and square man.

THE PRESIDENT—The question is upon the resolution. Shall we print a certain number of copies to be left with the Executive Committee for general distribution?

The motion was carried.

THE PRESIDENT—Next in order is the report of the Committee on Resolutions, A. F. Mason, Chairman.

MR. MASON—To your Committee on Resolutions have been referred only two. I will read the first:

"That a Committee of five be appointed, of which number the President of the Association shall be ex-officio one, the other four members to be appointed by the President, who shall offer their services to the authorities of the Columbian Exposition with a view to securing suitable facilities for the proper exhibition of electrical manufactures and appliances, and in general to work for the advancement of electrical interests and to offer the authorities of the Columbian Exposition the co-operation of the National Electric Light Association to aid in making the Exposition a success."

Your Committee recommend that this resolution be passed.

The second resolution which came to our hands is the following:

"That the Committee request the selection by the authorities of the Columbian Exposition of Mr. John P. Barrett to have practical charge and control of the electrical department of the World's Columbian Exposition."

Your Committee, recognizing the fact that, while before the present gathering, probably the larger part of the members of this Association had personally recommended the appointment of Mr. John P. Barrett by the authorities of the Columbian Exposition to the charge of the electrical department of the World's Columbian Exposition, yet that, on the floor of the Convention, members have expressed the opinion that it is outside the province of this Association to offer such recommendation, your Committee, therefore, return this resolution to the Association, suggesting that it act upon the same without suggestion from its Committee. (Signed by the Committee.)

THE PRESIDENT—Gentlemen, you have heard the first resolution reported back by the Committee, that a Committee be appointed, of which the President shall be ex-officio one, and four other members who will volunteer to offer their services to the authorities of the Columbian Exposition and co-operate with them in securing an exhibit of electrical apparatus, I suppose. What action will you take upon it?

MR. BROWN—Mr. President, I move that the report of the Committee as to that resolution be adopted. Seconded by Mr. Alexander.

THE PRESIDENT—The second is a resolution that the Committee request the selection by the authorities of the Columbian Exposition of Mr. John P. Barrett to have practical charge and control of the electrical department of the World's Columbian Exposition. The Committee return it without recommendation.

MR. ALEXANDER—I move that that resolution be laid on the table. Seconded by Judge Armstrong.

SECRETARY FOOTE—The vote as corrected, eliminating two votes that were challenged, stands 26 yes and 17 no.

THE PRESIDENT—The motion to lay on the table has prevailed.

On motion of Mr. De Camp, properly seconded, the Convention adjourned until 4 p. m.

WEDNESDAY, AUGUST 20.—AFTERNOON SESSION.

The session was opened by Mr. A. J. De Camp, of Philadelphia, who delivered an address on "The Value of Detail in the Care and Labor of Electric Light Stations." (See page 212).

During the discussion which followed the reading of the paper Mr. De Camp said that if a person wanted to give a contract for a light to burn six months in the summer, that man would be entitled to a very low price, because he was going to rent when the station wanted all the load it could get. But such conditions did not exist to any extent. The highest that he had ever had since he had been in the business was not over eighteen or twenty exclusively summer lights. It was not followed up because it was not considered a paying business.

MR. DE CAMP also stated that the price for a twelve month's contract for half night lights is 65 cents; for eleven months, 62½ cents; for ten months, 70 cents; for nine months, 75 cents; for eight months, 80 cents; for seven months, 85 cents; and for six months, 95 cents. For all-night lights he adds fifteen cents to each one of the above prices; that is, he charges fifteen cents more for all night lights than for half night lights.

In reply to a query from Mr. Wilmerding, Mr. De Camp said that there was a discount of ten per cent. if bills were paid before the 10th of the month, but that contracts were made without reference to the ten per cent. deduction. He also stated that in the effort to establish the new rules he lost about five lights on the six months basis.

MR. C. H. WILMERDING, of Chicago—In Chicago, on the twelve months' contracts, we charge 65 cents, with 15 cents discount, per lamp per night. But I am speaking of the arc light only. Where the wire is paid for by the customer it lets us out on the short contracts. If a customer does not want it for more than three months we have got to have some rule established by which we can give it to him; and they are willing to pay for what time they use the lamp. In that case it is the same to us whether the customer uses the lamp for three months or for a year. So long as he pays for the actual cost of construction, and we are getting our regular rates out of him, we will get out whole.

If a man wants the service, and wants us to charge for only the summer, then we have got to let him have it or else he will use something else. I think that we have got to accomodate ourselves more or less to the public demand.

MR. DECAMP—As for competing with gas I may say that I do not think that we have an arc light in service to-day that is burned with any reference to the cost of gas. I have never been asked to make a contract in that way.

MR. WILMERDING—My experience has been just the reverse. I find that they will figure exactly just what their gas is costing and then see whether they can get the electric light at a sufficiently small advance over the cost of gas to warrant them in paying for it. Six or seven hundred of our arc lamps are day lamps, which are burned in large dry goods stores where they have got to use artificial lights; and they would use gas if they could not get the electric light for what they consider a reasonable price.

MR. S. J. HART, of New Orleans—It seems to me that this is a question which can only be regulated by the managers of the different companies, for the reason that the conditions are different with different companies. Furthermore, the legislature of our State, at its last session, which adjourned thirty days ago, in one house passed an enactment regulating the price of gas and of the electric light, but it failed to become a law for the reason that the legislature adjourned before the bill reached the House of Representatives.

MR. A. M. RENSHAW, of Washington, D. C.—I will state that our experience in Washington has been substantially the same as it has been in Philadelphia. We found that we had a large demand for lighting in the fall months, commencing along in October, November or December, and generally ceasing about the first of the year. We found that it would be impossible to supply that demand without doubling, or perhaps even trebling, our capacity. We found, furthermore, that we could not charge a price that would warrant us in doing that kind of a business. The result was that for several years we have had to have two terms for the electric light, one for six months and one for twelve months. We rent no lights for a less term than six months under any condition whatever, and we have very few lights rented for six months.

The next paper, by Mr. H. L. Lufkin, of New York, on "The Proper Basis for Determining Electric Motor Rates,"[1] was then read by Mr. Jos. Wetzler.

In the discussion which followed the reading of Mr. Lufkin's paper, Mr. Ch. Wirt, of Chicago, remarked that it was a little bit too fair to the gas engine. He was not very familiar with those figures at present—not as familiar with them as he was at one time. He thought it would be a very large gas engine, and a very good one at that, which would give a horse power hour for twenty cubic feet. He was informed that with one kind of gas it would burn as high as fifty feet, that is, fuel gas. He quoted the result of a test where twenty-two feet was used per horse power per hour, but he would not expect to get that result with commercial work and small engines.

MR. FABEN, of Toledo, stated that the Otto gas engine people, of Philadelphia, will warrant that the engine will not consume to exceed twenty-two and a half feet per hour per horse power with an average commercial illuminating gas.

DR. LOUIS BELL, of New York, said that he had had occasion to handle in the last year and a half a large number of tests, both in this country and in Europe, and very few of them showed less than 23 or 24 feet of gas, although this figure was sometimes slightly better. Then, further, it was interesting to raise the question as to whether this so-called 20 feet per horse power hour is brake-horse power hour or indicated horse power hour. As a rule the friction comes in to play an important part, and, further, the amount of oil used in gas engines is very considerable, so that in one prominent test in England a short time since an allowance of some five feet of gas per horse power hour was made to cover the extra consumption of oil. A very considerable number of tests of small engines had been made, and although the lowest possible figures approximate somewhat nearly to those given, the average was very much higher, frequently nearer 30 feet than 20.

MR. WIRT also called attention to the fact that the gas engine uses water in considerable quantity. In some cases this expense would be well worth taking into account. Another matter in connection with the gas engine is providing for the exhaust; there must be a large free exhaust, and this exhaust can be led to a point which makes it dangerous in regard to fire, and which makes it necessary to protect it thoroughly.

MR. E. R. WEEKS—I would call on Vice-President Edgar. He has had a very large experience in this matter of motors.

MR. C. L. EDGAR, of Boston, stated that his efforts in the last year and a half to two years had been to sell motor current entirely by meter, that is, selling it by the absolute horse power hour; and of the last 400 horse power which had been used in Boston, 250 are now paying for their current entirely by meter at so much a horse power hour. A nominal charge of 10 cents an hour per horse power is made in making discounts from this down to 40 per cent., so that the minimum rate is 6 cents per hour, the average being between 7 and 8. This is irrespective of the size of the motor. It depends entirely on the number of horse power hours per day as compared with the maximum which that motor can generate. In other words, a one horse power motor might get just as good a rate as a 80 horse power motor, provided it used as much as its maximum, as if it were a larger motor. A man could put in any motor he pleased; he would simply be charged, when he was charged by contract, according to the maximum power which that motor used at any time, as measured by the ampere meter. If a person was going to use 5 horse power and he was inclined to put in a 10 horse power motor, they were very glad to have him do so, and would only charge for the 5 horse power if he used only 5 horse power. He had never heard of a case where a person was charged for 10 horse power merely because he happened to put in a 10 rather than a 5 horse power.

MR. H. M. SWETLAND, of New York, then read a paper entitled, "Standards of Economy in the Generation of Power,"[1] which was followed by an address by Mr. E. F. Williams,[2] of Beloit, Wis., on "Triple Expansion High Speed Engines for Central Station Work."

MR. A. V. GARRATT, of New York, moved, at the conclusion of Mr. Williams' paper, that the subject of Mr. Swetland's paper be referred to the Committee on Data, with the suggestion that if they are not going to make a specific report upon that subject that either a sub committee or a new committee be appointed to report at the next convention on the point touched upon in Mr. Swetland's paper. This was carried.

The report of the Committee on Revision of the Constitution was then called up, and Mr. M. J. Francisco, the chairman, read the proposed new constitution as follows:

CONSTITUTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

Article I.—Name.

This Association shall be entitled the National Electric Light Association.

Article II.—Object.

The object of this Association shall be to foster and protect the interests of those engaged in the commercial production of electricity, for conversion into light, heat or power.

Article III.—Membership.

Section 1.—Members shall be divided into three classes—Active, Associate and Honorary. Active members only shall be entitled to vote and take part in the deliberations of the Convention, and shall be corporations or individuals engaged in the business of producing and supplying electricity for light, heat or power, for commercial or public use.

Sec. 2.—In the case of a corporation, the membership may stand in the name of the company, and such company shall have the right to be represented at any meeting of the Association by any of its officers or directors, or by its regularly employed manager or superintendent.

Sec. 3.—Associate members shall be Electricians, Electrical or Mechanical Engineers, Manufacturers and individuals who are otherwise directly or indirectly interested in advancing the use of electricity, and shall have the right of attending all meetings of the Association except executive sessions.

Sec. 4.—Honorary members shall include those already elected as such, and such other persons as may be elected upon the unanimous recommendation of the Executive Committee and approved by a two-thirds vote of the Association.

Article IV.—Officers and Executive Committee.

Sec. 1.—The officers of the Association shall be a President, two Vice-Presidents, an Executive Committee of nine members, and a Secretary and a Treasurer, who shall be elected as specified in this Constitution.

Sec. 2.—The President and Vice-Presidents shall be elected to serve one year from the first of the month following the date of their election, and shall be active members. The President shall act as Chairman of the Executive Committee during his term of office. He shall not be eligible to re-election for two years after his first term has expired.

Sec. 3.—The Executive Committee shall be chosen from among the active members. The first Executive Committee elected after the adoption of this Constitution shall be divided into three classes. Class one shall serve for the period covered by three Conventions; class two for two Conventions; and class three for one Convention from the first of the month following their election, after which three members of the Committee shall be elected at each Convention to serve for three succeeding Conventions from the first of the month following their election.

1. See page 214.

1. See page 217.
2. See page 222.

Sec. 4.—The offices of Secretary and Treasurer may be filled by the same person. He shall not serve as a member of any committee; shall be eligible for re-appointment and election without limit; shall give a security bond in such sum and with such qualifications as the Executive Committee may determine from time to time, and shall perform such duties as said Committee may direct, subject to their approval.

Sec. 5.—The Secretary and Treasurer shall be nominated by the President and ratified by the Executive Committee. He shall serve for one year from the first of the month following the date of the President's election. He may be an active or associate member.

Sec. 6.—The Executive Committee shall be the governing body of the Association, and shall manage its affairs, pass upon all applications for membership, subject to this Constitution and such special rules or regulations as may be adopted by the Association from time to time, and five members of the Committee shall constitute a quorum.

Article V.—Meetings.

The annual meeting of this Association shall be held in February, and a semi-annual meeting may be held in August of each year, at such places as the Association shall determine, and on such dates as may be determined by the Executive Committee.

Article VI.—Quorum.

Fifteen active members of the Association shall constitute a quorum for the transaction of business.

Article VII.—Dues.

The annual dues of active members shall be twenty-five dollars and associate members twenty dollars, payable in advance, and shall cover the calendar year. Members in arrears for dues shall not exercise the privileges of membership. Any member in arrears for one year's dues shall be dropped from the rolls, and if he is reinstated he will be required to pay his dues for the year in which his membership lapsed.

Article VIII.—Election of Officers.

All officers shall be elected by ballot at the annual meeting of the Association. Vacancies in office may be filled by the Executive Committee to cover the term until the next annual meeting of the Association.

Article IX.—Permanent Office.

A permanent office of the Association shall be established in the city of New York, and shall be located, furnished and governed in such a manner as the Executive Committee may from time to time determine.

Article X.—Parliamentary Rules.

Roberts' Rules of Order shall be the governing parliamentary law of the Association in all cases not definitely provided for by this Constitution.

Article XI.—Voting and Proxies.

Sec. 1.—The roll call shall be ordered on the demand of ten members on any question before the Association. Unless ordered otherwise as specified in this Constitution, all voting shall be by voice.

Sec. 2.—Voting by proxy shall not be allowed at any meeting of the Association or any of its Committees.

Article XII.—Amendments.

Sec. 1.—Amendments to this Constitution shall be presented in writing, and shall be referred to a Committee to be elected by the Association before being acted upon. A two-thirds vote of all members present, entitled to vote, shall be necessary for their adoption.

Sec. 2.—No amendment shall be voted upon by the Convention at which it is introduced.

Mr. M. J. Francisco then moved the following resolution:

Resolved, That the report of the Committee on the Revision of the Constitution be accepted and adopted, and the new Constitution to take effect January 1, 1891.

On motion of Mr. S. A. Duncan, of Pittsburgh, the discussion of the resolution was made the special order of 11 a.m. Thursday. The meeting then adjourned.

THURSDAY, AUG. 21.—MORNING SESSION.

The Association met pursuant to adjournment at 11 a.m.

The proceedings were opened by Prof. J. P. Barrett, of Chicago, who inquired how Mr. M. J. Francisco obtained the figures on the Chicago municipal electric lighting plant, which were contained in his paper on "Municipal Lighting." The question was ruled out of order, as the special business for the hour was the consideration of the report of the Committee on the Revision of the Constitution, which was accordingly taken up. Articles I. and II. were adopted without dissent.

The Secretary then read Article III., to which Mr. A. F. Mason offered the following amendment, so that the section might read:

"Members shall be divided into two classes—Active and Honorary. Active members only shall be entitled to vote, and shall be corporations or individuals engaged in the business of producing and supplying electricity for light, heat or power for commercial or public use."

Mr. Seely—I second it.

The President—The motion has been made and seconded. I presume the gentleman understands the amendment as offered by Mr. Mason; and he will now proceed with his remarks.

Mr. Seely—I call for the reading of that again.

Mr. Mason—Will it be satisfactory if I again read the Article as it would read if it were amended?

The President—Yes; just read it as it would read if the proposed amendment prevails.

Mr. Mason—If my amendment prevails it will leave this section read as follows:

"Members shall be divided into two classes—Active and Honorary. Active members only shall be entitled to vote, and shall be corporations or individuals engaged in the business of producing and supplying electricity for light, heat or power for commercial or public use."

The President—Do the gentlemen all understand it?

Mr. Mason, in explaining the reasons for his amendment, stated that he was compelled in the Committee to say that he could not sign the report, and he had never signed it. He stated to the Committee that it seemed to him that this was, if not a deliberate and intentional, nevertheless a real, insult to every associate member; that it asked him to take a position here which no man could take and maintain his self respect; that it asked him to become a so-called associate member, but with absolutely no rights or privileges excepting those of sitting during the open-door sessions, but not when executive business was being considered—giving him not even the privilege of sitting during those times.

Things had been developed which seemed to render it necessary for the self-protection of the central station members, so that they should have just such a closed door association. He was not one of those who thought so, however.

Mr. T. C. Smith remarked that the associate members were a very valuable part of the Association, and he thought that nothing brought that out more strongly than the fact that in the first place the Association was founded for the benefit of central station men, that they might get information and help from it. In the present state of the industry in this country the central station is absolutely dependent upon the associate member in the manufacturer. There was not, he believed, a single central station in this country that manufactures its own apparatus, wires or its own supplies, except in such minor details as brushes and things of that kind, and there again he was dependent upon the copper men. The time might come when central stations may do, as some of them are now doing in Europe, make their own machinery; but, he thought, that time was pretty far off in this country. Now, when a central station man wished to get information about the merits or demerits of an apparatus or supplies, which he wished to purchase, if he went to another central station man to get his information, the chances would be that he would get an opinion, and that would be all; the material supplied by that man might not be used under the proper conditions, and the conditions intended by the manufacturer, and consequently it was not tried under fair conditions. But if they had associate members at the meetings, and a paper was presented by one of those associate members, or if they got up and made statements, which were not correct, there was sure to be some other associate member in the same line of business who would point out the defects, and the question would be discussed; and the best time for central station men to get the best knowledge, was when the associate members were quarrelling among themselves. (Laughter.) He was of the opinion that at present, the manufacturers were some of the best men in the conventien, men who are not simply salesmen, but who discussed things intelligently and who could meet the central station man on his own ground and make an effort to provide material and devices that should meet his wants; but if the supply men are only to have an opportunity to sell their goods, they would send around a salesman with a big sample case, and that would be the end of it.

He thought that when papers like that of Mr. H. L. Lufkin were received from the associate members, it showed the value of the associate members. A glance through the past proceedings of the Association would show that a great many of such papers have come from such men. He hoped that Mr. Mason's amendment would be voted down. (Applause).

In the ballot for the amendment, the votes of Prof. Barrett, and Messrs. Weeks and Hegeman, were challenged, but on motion admitted.

The amendment was lost by a unanimous vote.

Mr. Alexander then moved to amend Sec. 1 of Art. III to read as follows:

"Section I—Members shall be divided into three classes—Active, Associate and Honorary. Active members only shall be entitled to vote, and shall be corporations or individuals engaged

in the business of producing and supplying electricity for light, heat or power for commercial or public use."

The amendment was adopted.

On motion, Section III of Art. III was made Sec. II.

On motion of Mr. Alexander, the following was accepted by the Committee:

"Section II—Associate members shall be Electricians, Electrical or Mechanical Engineers, Manufacturers, and Corporations and Individuals who are otherwise directly or indirectly interested in advancing the use of electricity, and shall have the right of attending all meetings of the Association except executive sessions, and shall have the right to discuss papers read before the Convention."

MR. WHIPPLE moved the following amendment:

"Section II—Associate members shall be Corporations and Individuals, who are directly or indirectly interested in advancing the use of electricity, and shall have all the rights of active members except the right to vote." This was tabled.

MR. A. C. BROWN—I move to amend Section II. as it now stands, by striking it out and substituting another, which has been suggested to me by Mr. T. C. Martin, of THE ELECTRICAL ENGINEER, and which I now offer. The gist of the change is that, "Members shall be divided into two classes—active and honorary. Active members only shall be entitled to vote and take part in the deliberations of the convention; and shall be corporations or individuals engaged in the business of producing and supplying electricity for light, heat or power for commercial or public use, and electricians, electrical or mechanical engineers, manufacturers and individuals who are otherwise directly or indirectly interested in advancing the use of electricity." Later on, in defining the duty of the President and of the Vice-Presidents, the constitution would be amended to read:

"The President and Vice-Presidents shall be elected to serve one year from the first of the month following the date of their election, and shall be active members. The President shall act as Chairman of the Executive Committee during his term of office. He shall not be eligible to re-election for two years after his first term has expired. The President and Vice-Presidents shall be individuals or officers of corporations actively engaged in the business of producing and supplying electricity for light, heat and power for commercial or public use."

And a new article, as follows:

"*Article XIII. Section I.*—No vote, resolution or declaration of the Association shall stand, or form part of the record, until it has received the signature of the President, who is vested with the power of veto.

Section II.—Any vote may be called up for consideration at the convention succeeding that at which the vetoed measure was introduced, by a two-thirds vote of the members present, and said measure shall only become a valid act of the Association, without the signature of the President, upon then and there receiving an absolute two-thirds vote of the whole membership of the Association."

The amendment was tabled.

Section II. of Article III., as amended above by Mr. Alexander, and accepted by the committee, was then formally adopted, reading as follows:

"Section II.—Associate members shall be electricians, electrical or mechanical engineers, manufacturers, corporations and individuals, who are otherwise directly or indirectly interested in advancing the use of electricity, and shall have the right of attending all meetings of the Association, except executive sessions, and shall have the right to discuss papers before the convention."

On motion of Mr. Wilmerding, Section III, as reported by the Committee, was adopted, as follows:

"Section III.—In the case of a corporation the membership may stand in the name of the company, and such company shall have the right to be represented at any meeting of the Association by any of its officers or directors, or by its regularly employed managers or superintendent."

MR. GARRATT then moved that the following be added to Section IV. (which is Section II. as printed on page 233):

"No individual actively associated with a corporation holding an active membership shall become individually an active member."

MR. E. A. ARMSTRONG pointed out that if this amendment were adopted it would prevent any individual owning a plant supplying electricity for commercial or public use from becoming a member of the Association.

The amendment was lost.

MR. WHIPPLE offered the following amendment:

"Section III—In the case of a corporation the membership shall stand in the name of the company, and such company shall have the right to be represented at any meeting of the Association by any of its officers or directors, or by its regularly employed manager or superintendent, or by a properly accredited representative."

MR. ARMSTRONG—If Mr. Whipple will divide the amendments I will accept the first on behalf of the committee, but not the second. My reason for not accepting the second is this—and I think that he will see the force of the point: That exactly this one thing as suggested by Mr. Mason and by other speakers here can be accomplished by having plants send representatives who are engaged in other business, and not actively engaged in central station business. What we want is not to have the companies send their proxies, but what we want is the men who are actively interested in central station business.

MR. ALEXANDER—There is another reason why that ought not to be adopted. Only yesterday a gentleman told me that he was going to force a certain measure through, and he said that it was merely a question of money. He meant that he could go around to a hundred central stations that have no membership, and say to them, "I will pay your dues, and you can give me your membership." He can do that and then he can come here and rule the whole Association.

MR. WHIPPLE'S amendment was finally tabled.

Sections I, II, III, IV and V of Article IV were then approved.

MR. DECAMP—I would like to offer an amendment to Section VI so that it shall read as follows:

"Section VI—The Executive Committee shall be the governing body of the Association, and shall manage its affairs, pass upon all applications for membership subject to this constitution, and such special rules or regulations as may be adopted by the Association from time to time, and five members of the committee shall constitute a quorum."

He moved to amend by adding, after "membership," the words "and the eligibility of their representatives." Carried.

Articles VI, VII were then adopted.

MR. WHIPPLE—If you will examine Section V of Article IV you will notice a discrepancy between that and Article VIII. Section V of Article IV provides that the Secretary and the Treasurer shall be nominated by the President and ratified by the Executive Committee; whereas, Article VIII provides that all officers shall be elected by ballot. I move to amend Article VIII by inserting after the word "officers" the words "except the Secretary and the Treasurer." This was adopted as amended.

Articles IX, X, XI and XII were adopted.

MR. GARRATT—I would like to present a new article, to be known as Article V., and the subsequent articles to be set ahead one number, so that Article VI. would become Article VII., and so on.

"Article V.—No individual actively associated with a corporation holding active membership shall become an active member individually unless he shall own or operate a central station plant individually." This was adopted.

MR. ARMSTRONG then offered the following resolution:

Resolved, That the report of the Committee on the Revision of the Constitution be accepted and adopted, and that the new Constitution take effect January 1st, 1891. Carried unanimously.

MR. BARRETT—I want to ask Mr. Francisco where he secured the figures with regard to the expenditures in Chicago.

MR. FRANCISCO—In answer to Mr. Barrett's question, I will say that Mr. Barrett is too good a politician, and understands the working of these matters too well to expect that I would disclose the name of the party in Chicago who gave that information. He is inside of that combination, or whatever you call it. The information was given to me from parties who are perfectly reliable; and of course Mr. Barrett knows perfectly well that when such things are given in confidence they are not to be disclosed.

MR. BARRETT—Is not the matter of expenditures in any department of the city government a matter of public record?

MR. FRANCISCO—If Mr. Barrett can read the English language he can see exactly what my paper shows. It gives the wages paid the different men, and the amount charged up for depreciation; and that depreciation I figured myself. The other figures are actual figures as given me as paid for those items. There they are in plain language. There is no chance for misconstruing or evading them. There they are; and I am here to sustain them.

MR. BARRETT—I want to say for the benefit of the Association that there are but two items throughout that statement which are correct; one is the salary of the engineer, and the second is the number of lights. As to the total expenditure as charged by you, there is the slight difference between that and the actual expenditure and what you credit as expenditure, of $35,190. I do not believe that you want to do the City of Chicago, or any one else, an injustice.

MR. FRANCISCO—I did not intend to reflect in any way upon the City of Chicago or upon Mr. Barrett; but it has gone broadcast over the country that it only cost nineteen cents per lamp to furnish light in Chicago.

MR. BARRETT—I just want to say this: That if the balance of that document is in accordance with the statements made for Chicago, then it is the biggest tissue of falsehood that I ever saw published in my life—with all due respect to the Association. I want to ask if you desire to send broadcast the truth about municipal lighting, and if you do, that you will appoint a committee—of whom you will please except this gentleman here, and except him only—and I will pledge you my word of honor that they shall see every document in Chicago, from the date of its inception to the present time; and if it sustains that statement I will

pay the expenses of this committee. I appeal to you, gentlemen, if there is anything more honest or square than that, I want to make it.

MR. ARMSTRONG—Such a statement we would be glad to receive; it will be just the information that we want; and if he would send it to the secretary I have no doubt that the president, or the executive committee, will order it sent to each member of the Association. I move the adoption of the resolution:

After hearing the statement made by Prof. John P. Barrett in relation to the municipal lighting of Chicago,

Resolved, That Professor Barrett be requested to communicate to this Association a statement showing the cost of producing and maintaining electric lights in the city of Chicago.

MR. BARRETT—Let me suggest that it include the cost of construction also.

I want to say with regard to the items of expense that I have to buy the same material as others, and the market is as open to me as it is to others. I am sorry to feel the way I do about this. I have to be as careful of my expenditures as any of you. The people of Chicago are careful of their funds, and we have been short, and we have tried to make a dollar go as far as anybody can do. The market is as open to us as it is to you for the same class of apparatus; and I do not pay any more than the rest of you do.

MR. FRANCISCO—Do you not pay more for labor; and do your men not work eight hours, at $2.00 per day?

MR. BARRETT—The labor only costs more. I do pay $2.00 per day and the men only work eight hours per day.

The resolution of Mr. Armstrong was adopted and Mr. Barrett said he would have the paper ready inside of one month.

Convention then took a recess.

THURSDAY, AUG. 21.—AFTERNOON SESSION.

THE PRESIDENT appointed on the Committee on the Columbian Exposition, P. H. Alexander, Oldtown Electric Light Co., Oldtown, Maine; George H. Roe, San Francisco Electric Light Co., San Francisco; S. J. Hart, Louisiana Electric Light Co., New Orleans, and Mr. Edwards, of the Charleston Electric Light and Power Co., Charleston, S. C.

SECRETARY FOOTE then read the report of the Secretary and Treasurer, as follows:

REPORT OF SECRETARY.

Membership.

Active members, dues paid	79	
Active members, dues unpaid	28	
Total active members		107
Associate members, dues paid	128	
Associate members, dues unpaid	34	
Total associate members		162
Total membership July 1, 1890		269
Total membership January 1, 1890		259
Gain in membership for the six months.		10

REPORT OF TREASURER.

Balance January 1, 1890	$ 610.17	
Received from January 1 to July 1.	3,020.00	
Total to be accounted for		$3,630.17
Expended from January 1 to July 1 per approved vouchers on file	$2,396.57	
Balance in bank July 1, 1890	1,233.60	
Total accounted for		$3,630.17

The report was received and ordered spread upon the minutes.

MR. A. V. GARRATT then read the resolutions of regret relative to the deceased members, Messrs. M. W. Goodyear and Ch. McIntire, which were adopted by a rising vote.

MR. C. R. HUNTLEY then made a short verbal report of the work of the Executive Committee.

THE CHAIR then announced as a Committee on Nominations for Executive Committee, Messrs. T. C. Smith, De Camp, Armstrong, Long and Alexander.

MR. J. A. SEELY, Chairman of the Committee, read the report of that Committee, as follows:

Balance December 31, 1889	$ 610.17
Receipts	3,020.00
Disbursements	2,396.57
Balance June 30, 1890	$1,233.60

The committee recommended that hereafter, whenever a committee is appointed, the executive committee shall fix the maximum amount it will allow for the expenses of such committee and notify its chairman that vouchers for the expenses of his committee will be allowed within the limit specified and no more.

MR. BURLEIGH moved that the report be received and filed and the recommendations carried into effect. Carried.

MR. C. H. WILMERDING then read the report of the Committee on Underground Conduits and Conductors, Joseph E. Lockwood, Chairman.

REPORT OF THE COMMITTEE ON UNDERGROUND CONDUITS AND CONDUCTORS.

At the Kansas City convention, held last February, the following members were appointed a Committee on Underground Conduits and Conductors, viz.:

J. E. Lockwood, of Detroit, Mich.
C. H. Wilmerding, of Chicago, Ill.
S. S. Wheeler, of New York.
T. C. Smith, of Philadelphia, Pa.
D. E. Evans, of Baltimore, Md.

Your committee now desire to report that they have perfected a plan of work, but before carrying out the same desire the opinion of the Association and any suggestion that members especially interested may desire to make.

The plan of work adopted is, first to secure from each electric light or power company operating any high tension, underground conductors a full description of the conduit and conductors in use, the character of the current used, and how long the same has been in use, which information, when classified and tabulated, will indicate plainly the condition of the subject at the present date, and will give us a starting point to work from. We then intend to secure the co-operation of these companies as our next step, which will be to have each company keep account of the cost of maintenance and repairs, to the conduits and conductors, and of all changes or additions thereto; also of the average hours per day the system is operated. This information, when classified and tabulated, will show the cost of operating underground conductors, and, if regularly reported to the committee, will show whether or not progress is being made in this direction, and whether the systems in use are likely to prove permanently successful or to finally fail. It is also designed to include in these reports a list of all grounds, burn outs, etc., and their causes, with suggestions looking to the removing of said causes.

The committee would, of course, keep private the names of all companies furnishing such information, simply reporting the same in tabulated form. These reports would be invaluable to companies operating such conductors, as they would have not only their own experience to improve upon, but also that of all other companies operating underground conductors.

In regard to the details of the plan of work proposed, we have decided on first obtaining the following information, viz.:

Conduits.

1. A full description of the conduit used, kind of man or hand holes, provision for taking off service, etc.
2. Mileage of conduits laid and in use.
3. Mileage of duct laid and in use.
4. Number of man holes.
5. Number of hand holes.
6. Length of time in use.

Conductors.

1. Description of the conductor in use, stating size of conductor, kind and thickness of insulation, and, if insulation is covered, in what manner.
2. How long same has been laid and in use.
3. Mileage of conductors laid and in use.
4. Average hours per diem same is operated.
5. Electro-motive force and character of current used.

The above information would give us a good basis to work on; we would then endeavor to have each company operating high tension underground conductors keep the following records, and report the same regularly to the committee, just before each convention, so that it could be properly classified, tabulated and reported.

Conduits.

Mileage of conduit laid and in use.
Mileage of duct laid and in use.
Number of man holes.
Number of hand holes.
Number of services taken direct from conduit.
Cost of maintenance per month.
Cost of repairs per month.
Description of any new work done since last report.
Troubles with conduit, man or hand holes and suggestions as to how same can be remedied.

Conductors.

Mileage of conductors laid and in use, number of circuits and mileage of each.
Cost of maintenance per month.
Cost of repairs per month.

Number of burn-outs, and causes.
Troubles of other kinds and causes.
Suggestions as to how troubles can be remedied.
Average hours per diem circuits are operated.
Voltage and character of current used.

Changes or New Work.

Mileage of conduit or conductors abandoned.
Mileage of conduit or conductors added since last report.

The above reports would, of course, be separately classified for different kinds of conduits, conductors and currents.

Your committee think that these records should be kept continuously and reported regularly, until the question of operating high tension underground conductors is solved or effectually disposed of, and to do this we recommend that the committee be made permanent, and that members be elected annually at the February conventions.

The committee should report at each convention:

The number of companies operating high tension underground conductors.

The mileage of conduits, ducts and conductors in use.

The cost per mile per month of conduit maintenance and repairs.

The cost per mile per month of conductor maintenance and repairs.

The average number of burnouts and grounds per mile of conductors used and the causes. It should also report all conduits, conductors, etc., that had proved failures and were abandoned.

In this manner the Association would keep thoroughly posted regarding the progress of the subject, and would be supplied with the actual records made by the different systems; the members of the Association could then judge for themselves of the success of the different systems, and thus be able to act intelligently in case they desired to do any work in this line.

As this plan is intended to extend beyond the time for which this committee was selected, we have recommended that the same be adopted by the Association and that provision be made for the annual appointment of members to the committee. If this meets the approval of the convention, we would appreciate any suggestion from members who are especially interested in this subject, looking to the perfecting of the plan of work.

MR. WILMERDING added that in his opinion one point had been omitted in regard to the cost of the conduit that is down. That cut a very important figure in the estimate of what it really means to operate underground conductors, and thought the Committee ought to have the privilege of adding any such questions to their catechism which they will submit to the companies using underground work, which they thought might be necessary.

The report was adopted.

The report of the Committee on Relations between Manufacturing and Central Station Companies was then read by Judge E. A. Armstrong, a member of the Committee.

REPORT ON THE RELATIONS BETWEEN MANUFACTURING AND CENTRAL STATION COMPANIES.

The vast sums of money now invested as capital in the United States in the various electric light and power companies make the subject with which this Committee has to deal more than ordinarily important.

From every point of view the policy that has been more or less surreptitiously pursued by parent companies in *permitting* their agencies, for the sake of a present sale of apparatus, to foster and encourage improper and hurtful competition with present central station companies, cannot in our judgment be too strongly condemned by this Association.

Capital has been induced, in spite of its proverbial timidity, to invest in what has been an unexplored field. Often this investment has been brought about by the parent companies themselves. Then when it has seemed as if the stormy days of doubtful experiment were about over, and there was some little possibility that this investment might begin to make returns, along comes the agent of some parent company and by specious representations induces other citizens of the same place to start a new plant, always forgetting to tell of the weary journey of the pioneer company, and pointing always to present position. The only province of this new plant is to damage and destroy what did give some promise of life and fruit; and incidentally to make a market for a little new apparatus, effectually closing, however, a profitable avenue of steady continuing business in sales to the original companies.

It is rumored very strongly, and indeed stated as a fact, strange as it may seem, that parent companies, not satisfied with permitting, have gone so far as to actually organize, central station companies in competition with others which are abundantly able to supply all demand, strengthening, supporting and sustaining them in their unholy warfare against legitimate enterprise.

Such being the case, your Committee would earnestly recommend either its continuance or the appointment of a new Committee with power to confer and advise with any companies against whom such warfare is waged, and that through such committee the members of this Association as central station companies, pledge sympathy, assistance and protection to any company so being fought; and that such committee be instructed to represent to the various parent companies that the conduct we have above deprecated is something so fatally injurious to us and to our stock holders as to make our investments uncertain and undesirable, and that, therefore, we will as one Association feel not only justified in, but required to take the strongest possible means of remedy and prevention within our power, whenever we find a parent company engaging in, or permitting, such a course of conduct. When it has already been started, any such company so minded can readily stop it.

The report of the Committee was received and the Committee continued.

The Committee on Data, A. J. De Camp, Chairman, reported progress.

THE PRESIDENT then announced the topic, "How the National Electric Light Association can Best Serve the Interests of Central Station Companies?" by Mr. C. R. Huntley.

MR. HUNTLEY—I think that this topic might be discussed upon another heading, and better still, viz., How can the Central Station Men Best Serve the National Electric Light Association? As we look about us to-day here we see perhaps thirty-five or forty central station people; in fact they are in the minority. We find a great many supply men here taking an active part in it; but conspicuously the central station men are not as active in their membership or in respect to their pocket book to aid the National Electric Light Association as they might be. I think, to put the whole matter in a nut-shell, that the National Electric Light Association should be purely a business association, and in being that they will best serve the central station men.

THE REPORT of the committee to nominate an Executive Committee for the ensuing six months and to name a place of meeting was then read, unanimously recommending as the next place of meeting, Providence, R. I., the time to be announced hereafter by the Executive Committee. The committee also unanimously concluded that it is only due to the Executive Committee, and to the work which they have so thoroughly done, to continue that committee, the only change made being the substitution of Mr. A. J. DeCamp for Mr. Thurber, by request. The report was adopted.

SECRETARY FOOTE cast the ballot for the Executive Committee as follows: C. R. Huntley, Chairman; E. R. Weeks, C. H. Wilmerding, J. J. Burleigh, M. J. Francisco, J. A. Seely, James English, A. F. Mason, A. J. DeCamp.

On motion, Providence, R. I., was made the next meeting place of the Association.

The convention then adjourned *sine die*.

THE ELECTRICAL EXHIBITS AT CAPE MAY.

FOLLOWING the example of past years the various electrical supply houses took to Cape May this year most interesting exhibits of all the novelties which have been introduced to the trade this year. Every available parlor on the ground floor, and space in the large hall of the Hotel Stockton, was utilized for the purpose of showing exhibits, and though there was no power available, the showing was a very good one.

CROCKER-WHEELER MOTOR CO.

Entering at the main entrance of the hotel, the first exhibit that attracted notice was that of the Crocker-Wheeler Motor Company, of New York, represented by Messrs. F. B. Crocker, S. S. Wheeler, and T. McCoubray. On one end of their table, which was well decorated with a frame and canopy, and their name in large letters, was a 1-6th horse power motor, belted to a pump manufactured by the Gould's Manufacturing Company, of Seneca Falls, N. Y. This motor is capable of furnishing sufficient power to enable the pump to lift 100 gallons of water per hour 80 feet, equal to a pressure of about 40 pounds. On the other end of the table was a 1-2 horse power motor, geared direct, and sitting on the same cast-iron frame with another form of Gould pump. In the centre of the table was a 1 horse power motor of the slow speed type, making only 1,030 revolutions per minute. There were also a number of small motors for fan and other purposes, and the method which they adopt of fixing on the guard frame of the fan is worthy of mention, as being peculiarly substantial, and it is easily put on and taken off. There was also exhibited an arc motor and one of the pulleys which are used on this motor, showing the centrifugal governor contained inside, by means of which the armature is moved in and out of the field. The rheostat for controlling the motor was also shown. It is so arranged that the field is cut in before the armature, in starting up the motor, and is cut out last in stopping, so that there is no violent motion in starting or stopping. The pulleys on the small motors are also worthy of mention, being exactly like ordinary iron dynamo pulleys, with flanges, though very small. We present herewith a fine chromo-lithographic print of the motor. (See supplemental inset.)

ELECTRICAL SUPPLY CO., OF CHICAGO.

Adjoining the exhibit of the Crocker-Wheeler Company was a table occupied by the Electrical Supply Company, of Chicago, and Ansonia. They did not make any exhibit this season, but had a large supply of interesting catalogues and circulars. Suspended over the table they showed the latest specialty, the Bradner Adjustable Lamp Hanger, by which lamps can be suspended at any desired height by merely moving the hanger up or down, the slack of the cord being all taken up inside the hanger, which is spherical in form to contain the lamp cord. The Electrical Supply Company, was ably represented by Mr. Charles Wirt, of Chicago, and Mr. F. B. Platt, of Ansonia.

UNITED ELECTRIC EQUIPMENT CO.

Continuing along the main hall, the only other exhibit in this part of the building was that of the United Electrical Equipment Company, 706 Walnut street, Philadelphia, who are agents for the Wenstrom Consolidated Dynamo and Motor Co., the George M. Stevens system of town and city fire alarm, and the American Fire Alarm Company, of No. 71 Kilby street, Boston. They exhibited one of their well known Wenstrom dynamos, of 32 light capacity, and had the armature out, so as to show the peculiar construction. The armature is composed of laminated iron discs, but the wire, instead of passing around the outside of the cylindrical mass of iron plates, is threaded through holes in the rims of the discs. The whole armature is then turned down, and there being no wires on the surface, the armature can be made to fit very snugly in the field. They exhibited also samples of the special gears of Chadbourne, Hazleton & Company, recently illustrated in the columns of THE ELECTRICAL ENGINEER. These gears are composed of metal frames with wooden teeth, which can readily be replaced when worn out. A very neat exhibit shown by this company, and one which attracted a good deal of attention, was the model of a complete electric elevator plant, driven by a small Wenstrom motor. The carriage carrying the grooved pulleys is operated by a screw shaft, cut with a right and left hand thread. When hoisting, the pulleys are thus separated from one another and thus pull in the rope which goes to the elevator. When lowering, the pulleys are brought closer together, by the screw shaft revolving in the opposite direction, the motor operating the shaft being reversible. This company also exhibited a very complete set of instruments of the automatic fire alarm system of the American Fire Alarm Company, and had the instruments connected by auxiliary boxes of the George M. Stevens city fire alarm system, which were temporarily connected to the fire department of Cape May. A fire alarm bell had been erected in the pagoda in front of the hotel, and the guests of the hotel were treated to an exhibition of the automatic fire alarm, by which the fire department turned out to extinguish a supposed fire in the Stockton Hotel. The experiment was successful in a very striking manner. Mr. Chas. Russell, of Philadelphia, and Mr. E. F. Woodman, of Boston, were in charge of the exhibit. They had a very complete set of blue prints, illustrating their motors as applied to elevators, street car work, mining machinery and various other purposes.

INTERIOR CONDUIT AND INSULATION CO.

Passing down through the ladies' parlor towards the dining room, the Interior Conduit and Insulation Company, of New York, occupied a very commodious parlor and showed up their specialties in conduits both for house and underground work. Samples of their tubes and junction boxes were exhibited on a very handsome polished mahogany board, extending all the way across the room. The tubes are generally made black for ordinary concealed work, but they can be enameled in any color to correspond with any style of decoration for exposed work. The junction boxes can now be made of any material and decorated beautifully, and really form an ornamentation to the most elegantly furnished room. Some of the samples shown were particularly attractive in design, bearing medallion portraits of Morse, Edison, Faraday and Faure. A sample of their underground conduit was also shown, models being exhibited, one of the conduit complete and the other made to open up, exposing the tubes resting on insulating rings before the compound is poured in. There were also hung on the walls a most interesting collection of blue prints, showing the design of the manholes for the underground system, which have some novel features. The conduit, instead of entering the manhole horizontally in the ordinary way, enters in an upward slope, the top of the conduit coming near the top of the manhole, enabling the cables to be easily drawn in without using any winch or other apparatus in the manhole. Joints can also be more conveniently made, and the cables can then be covered up by an insulating sleeve. The Interior Conduit Company distributed a very handsome pamphlet of testimonials, containing letters of endorsement from all of the leading electricians of the day. The exhibit was in charge of Mr. E. H. Johnson, the president of the company, ably assisted by Mr. E. W. Little and Mr. Edwin T. Greenfield.

THE JORDAN TROLLEY WIRE SUPPORT.

IN erecting trolley wires for electric railways the custom is generally followed of soldering the wire to a metallic support. This operation is attended with considerable inconvenience. At the same time the span wires supporting the trolley wire are usually made with joints at the centre over the trolley wire, instead of in one piece, and hence introduce a source of weakness at that point. To remove both these inconveniences, Messrs. L. F. Jordan & Co., of Boston, Mass., have recently brought out the trolley wire support illustrated in the accompanying engraving.

THE JORDAN TROLLEY WIRE SUPPORT.

The hanger or support consists of two pieces or jaws, each provided with lugs, which extend under and support the trolley-wire when the jaws are screwed together. The jaw is provided at its opposite ends with lugs, between which and the ear of the jaw the trolley-wire is extended, the lugs preventing the trolley-wire from being lifted upward.

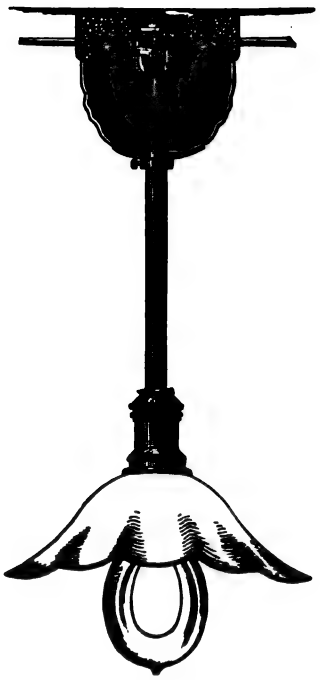
The support is provided, as shown, with an upright arm, having at its end a hook, which is fitted upon the hub of an insulating disc, both being provided with a slot by which the disc can be placed upon the span-wire. The hub of the disc, as shown, has also mounted upon it a like slotted disc, these discs being provided on their outer side with extended hubs, which are fastened to the span-wire by clamps.

In erecting, the set-screws are unscrewed, so as to permit the discs to be turned so that the slots will register with the slot of the hook, so that the hanger may be readily slipped upon the span-wire; then the discs are turned so as to bring their slots out of line with the slot of the hook, and secured in that position by the clamps. It will thus be seen that the hanger is insulated from the span-wire and has a pivotal movement upon the same.

The trolley-wire is thus firmly clamped between the jaws of the hanger, and is secured positively without the use of solder, and is prevented from falling at the points of suspension. The guy-wire is also endless, so that there is no weak spot in it. The device was exhibited at the Cape May Convention.

THE BRYANT ELECTRIC COMPANY.

In the same hall was an exhibit tastefully designed by the Bryant Electric Company, of Bridgeport, Conn., displaying the famous Bryant switches, rosettes, lamp sockets, Orford pendant rosette and other specialties. The Bryant Company have now got thoroughly reorganized and are in the market for a large business, and have a large number of men at work in their new factory at Bridgeport. They were ably represented by Mr. W. C. Bryant and Mr. J. M. Orford. The Bryant switch was illustrated in THE ELECTRICAL ENGINEER last week. The Orford pendant is shown herewith. It is a neat and handy contrivance, allowing the pendant play and swing on the hook in such a manner as to prevent all possibility of disconnection or dislocation, and preventing the occurrence of fires by abrasion of insulation or loose contacts.



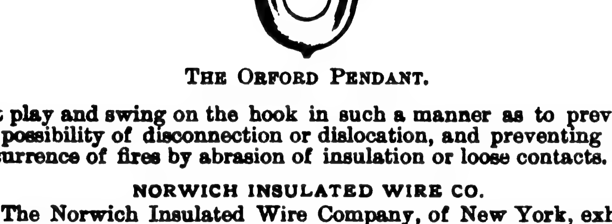
THE ORFORD PENDANT.

NORWICH INSULATED WIRE CO.

The Norwich Insulated Wire Company, of New York, exhibited a large and varied assortment of samples of their insulated wires and cables, and were represented by Mr. L. D. Beck, president of the company, and Mr. J. A. Wetmore. These wires are insulated with manilla paper wound spirally on, and then treated with a heavy gummy oil, which parchmentizes the paper, and is then lead covered. Paper when dry offers an extremely high insulation resistance. As a sample of the high value of this insulation, two samples were shown, each cut from a 1,300 foot length, one covered with the paper and lead covered, without being treated with the compound, which took 9,120 volts alternating current to break down the insulation. The other, a thoroughly finished cable, successfully withstood 9,440 volts alternating current, and could not be broken down. It is interesting to note that Ferranti, in London, is now experimenting with these cables for his 10,000 volt circuits, and up to the present time is thoroughly satisfied with them.

STAR ELECTRIX CO.

The Star Electrix Company, of 1320 Wallace street, Philadelphia, represented by Mr. Norman Marshall, president and manager of the company, showed some samples of single and double pole switches, insulating joints for coupling and insulating gas fixtures, and an insulating attachment for fixing incandescent lamps to ordinary gas fixtures, which can be made in brass or any other colored metal, as desired. The attachment is illustrated on this page.



STAR ELECTRIX INSULATING ATTACHMENTS.

EUREKA TEMPERED COPPER CO.

In the same hall with the Sawyer-Man Co., the Eureka Tempered Copper Co., of North East, Pa., had an interesting exhibit of copper castings made out of absolutely pure copper, and tempered by their patent process to any desired gauge. In their exhibit were shown samples of commutator segments, dynamo brushes, rolled copper for brushes, spring rolled copper, journal bearings, and copper castings of various kinds. The Eureka Company claim that they can now temper copper to a razor edge, if necessary, and yet at the same time it can be welded perfectly, and Mr. A. L. Daniels, their representative at the convention, distributed a number of pamphlets, setting forth their many claims for the use of tempered copper for all electrical work.

WARNER ELECTRIC LIGHT GAUGE.

IN electric light stations operating arc lights it is of considerable importance to keep the current on the circuits constant, and notwithstanding the regulating apparatus, some indicator is required to allow the attendant to watch the condition of the circuit. To accomplish this the Warner electric light gauge has been designed by the Standard Time Co., of New Haven, Conn., and which is illustrated in the accompanying engraving. The electric gauge resembles the ordinary steam gauge and has a large dial about 6 inches in diameter, which can be easily seen at a distance.

The arrangement is such that when the current at which the circuit is designed to operate is normal, the pointer stands at zero. The figures "above" and "below" represent the variations in amperes above or below the normal strength. Thus, if the pointer stands at 1 above, the current flowing would be 11 amperes, and if at 1 below, 9 amperes.

THE WARNER ELECTRIC LIGHT GAUGE.

The small pointer shown through the opening in the dial will point in the direction that the current is flowing, which indicates the negative binding post.

The gauge is furnished with an alarm attachment which may be set to ring when the pointer is at any point desired, above or below the normal, thus calling the engineer's attention when anything is wrong.

This gauge was exhibited by Mr. Warner at the Cape May Convention, where he also showed the ingenious pocket and office gauges for testing the condition of batteries. For secondary battery work the pocket size ranges from 1 to 3 volts and indicates $\frac{1}{10}$ volt with accuracy. The office gauge is intended as a fixture in the battery room with leading wires that can be applied to the terminals of any cell, so that its condition can be readily determined.

Mr. Warner also exhibited his fire alarm gauge, intended to be placed in fire alarm circuits to indicate continuously the condition of the line current.

CONNECTICUT MOTOR CO.

The Connecticut Motor Company, of Plantsville, Conn., exhibited a very handsome ½ horse power motor, which attracted much attention, and received universal praise for its high finish and neat appearance This company is now furnishing a number of motors for ventilating fans in government boats, and is just preparing for a very heavy business in the fall. Mr. J. R. Stagg and Mr. Roberts had charge of the exhibit.

EVANS FRICTION CONE CO.

The Evans Friction Cone Company, of Boston, were represented by Mr. H. J. Conant, and had no special exhibit, but distributed large numbers of catalogues, and blue prints showing in detail their system of driving dynamos by the Evans friction pulleys. The company are now engaged on a number of central station plants, and their system is being widely adopted, on account of its economy, compactness and durability.

SAWYER-MAN ELECTRIC CO.

Coming back to the side-hall on the left of the entrance the Sawyer-Man Electric Company, of New York, had an interesting display of their various electric specialties. On the wall was a large case containing samples of their different varieties of lamps for straight incandescent and series incandescent lighting. The series lamp is mounted on a socket containing an automatic cut-out with resistance to replace the lamp should the filament break or burn out. All the exposed parts are made of insulating material. On the table in the centre of the room were exhibited the new branch cut-outs made of porcelain, their regular form of single and double pole switches, cut-outs, rosettes, sockets, detachable plugs, Field's mercury cut-out and other specialties. Probably the most interesting feature of their exhibit was the new insulating material which the Sawyer-Man Company are introducing, and which they have named "Alexite." This material is fire-proof, water-proof and acid-proof, not fragile, highly durable, and can be moulded into any desired shape; but the most marvellous quality it possesses is the infinite variety of shades and colors it can be made to assume. A neat manner of showing how closely different colors of wood and marble could be imitated was adopted by having samples of all the known woods generally used in decorating rooms, on the table, with sample of marble and other polished stones, and on top of each sample was placed a sample of "Alexite," so closely imitating it, that the difference could hardly be noticed. For the manufacture of cut-outs, fuse boxes, rosettes, etc., this material lends itself naturally, and its property of being able to take on any desired finish must commend itself to electrical contractors, especially for exposed work in houses where something better and more ornamental than ordinary is required. Mr. P. H. Alexander and Mr. Morris, of New York, had care of this exhibit.

JORDAN TRAIN LIGHTING CO.

The Jordan Train Lighting Company exhibited samples of their electric light coupling for joining cars together, so that the current from one car can pass conveniently into the other. The coupling has only to be pushed closely together to form the connection, and it can be pulled out at any moment. The whole coupling and connecting wires are thoroughly water-proof. They also exhibited samples of their new trolley line suspender, which does away with any necessity for soldering, and which is meeting with well merited success.

INDURATED FIBRE CO.

The Indurated Fibre Company, with headquarters at 40 Wall street, exhibited samples of their indurated fibre pipe for underground conduits, showing straight pipe, joints, and junction boxes. A sample of the pipe was also shown, made out of the fibre before being treated with the compound, displaying the close nature of the fibre. They also exhibited samples of pails and other goods, specially a keg which they have designed especially for containing powder. The lid is screwed on, making a hermetically sealed keg. The conflict on the patents of this material is now settled; this company have control of all the patents, and have capitalized two companies at $1,000,000 to push their goods, one for electrical purposes, and the other for all mechanical purposes. The material weighs only one-fifth of iron pipe, has a tensile strength of 1,100 pounds to the square inch, resists about 250 degrees of heat, and is perfectly water and gas tight. The exhibit was in charge of Mr. G. S. Bowen.

WASHBURN & MOEN MANUFACTURING CO.

Washburn & Moen Manufacturing Company, of Worcester, represented by Mr. H. M. Smith, exhibited a handsome case containing a complete line of samples of bare and insulated copper wires, soft and hard drawn, solid and stranded. They also showed a sample of 2¾ inch stranded bridge cable, and Mr. Smith distributed a little pamphlet, entitled "Electrical Memoranda," which was in great demand, giving a historical account of electrical events, showing the close connection with the great and ever increasing demand for copper, and containing a variety of useful data.

AMERICAN WALTHAM WATCH CO.

The American Waltham Watch Company were ably represented by Mr. H. E. Duncan, of Boston, who exhibited no samples, but spent his time largely in the exchange of social courtesies with a host of friends.

R. T. WHITE.

Mr. R. T. White, of 12 Pearl street, Boston, exhibited a number of his patent chairs for supporting railroad metals for electric railroads, and which are being largely adopted all over the country for first-class electric railways.

EDDY ELECTRIC MOTOR CO.

The Eddy Electric Motor Company, of Windsor, Conn., was ably represented by our popular friends, Mr. A. D. Newton and Mr. M. E. Baird, but exhibited no samples, their motor being so well known now that they evidently required no representation, other than personal.

SEELY'S FLEXIBLE WIRED MOULDING.

It is safe to say that few of the exhibits attracted so much attention as Mr. J. A. Seely's new "flexible wired moulding." As our readers are aware, the whole subject of interior wiring has of late been most vigorously and thoroughly stirred up, and departures revolutionary and radical in their nature have been made, to such a remarkable extent that we have really entered upon a new era in this important field of work. Mr. Seely's ingenuity and versatility have long been tried and proved in the whole round of electrical application, and hence it is not surprising that he should come forward with a means of his own for meeting the obvious and serious difficulties of wiring work. The device or appliance is not exactly new, as we had the pleasure of being shown it by its inventor some months ago, but it is now to be actively pushed, and its novelty at once appeals to the electrical public. Mr. Seely has hit upon the ingenious idea of making his moulding out of rubber, and in this moulding at the same time he imbeds his wire. In other words, he wires his moulding before he puts it up, or, to state it another way, he insulates his wire with rubber moulding and then puts it up. This flexible wired moulding is made in all the various sizes of wire ranging from No. 16 to No. 0, and comes in any length required. It shows under test the high insulation of 500 megohms between the positive and negative conductor sides. The moulding corresponds, of course, to ordinary wooden moulding and answers exactly the same conditions, as well as having a number of advantages distinctively its own. It can be placed on ornamental ceilings and walls without defacing them, and will take any decorative finish required. It is also peculiarly applicable in old houses and buildings where it is impossible to get behind the walls or to bury the wires in the plaster. It can be handled in rolls of several yards, cut to any needed length, and carried right to the spot, with the consequent avoidance of expensive carting, and the cutting, sawing, etc. Not a few customers for the light object very emphatically to the sawing and cutting on their premises. The Seely & Taylor Manufacturing Co., who are introducing this specialty and exhibited it at Cape May, have worked out also a full line of branch blocks, tees, etc., together with a special form for the purposes of turning right angles and taking off branch circuits. It is claimed that a saving of not less than 40 per cent. is made over the old methods, and this alone is enough to ensure an enormous demand. A singular instance of appreciation was afforded a week or two ago when, the moulding having been used by one local company in a large city, another competing local company ordered a large quantity, saying it was an absolute necessity and it could not afford to try to do without it.

The moulding, it should be added, is also handled by the Okonite Co., who are its manufacturers for the Seely & Taylor Manufacturing Co., and who have lately put in a large plant for its production. Under such favorable circumstances, it is expected that the moulding will at once go into use everywhere.

THE OKONITE COMPANY, OF NEW YORK.

The Okonite Company occupied a comfortable parlor on the ground floor, and Capt. W. L. Candee and Mr. George T. Manson, of New York, looked after the interests of their numerous friends. Handsome photographs of different rooms in their new factory at Passaic, N. J., decorated the walls, and on the table were displayed a complete assortment of samples of their Okonite cables, tapes, wires and flexible cords. They also showed samples of the Seely flexible moulding, which they manufacture in large quantities.

SPERRY ELECTRIC CO.

The Sperry Electric Co., of Chicago, exhibited on one of the poles of the local lighting company, in front of the Hotel Stockton, probably the greatest novelty at the convention, namely, their new Triple Carbon Arc Lamp, specially designed to avoid the broad patent, held by the Brush Electric Company, on double carbon lamps. The triple carbon holders can be attached to any of their ordinary single or double carbon lamps. There are two upper cylindrical carbons, and a lower flat one, and it is stated that by this arrangement the lamp will burn for 16 to 18 hours. The exhibit was in charge of Mr. Charles E. Gregory, who also showed drawings of mining machinery.

NEW YORK INSULATED WIRE CO.

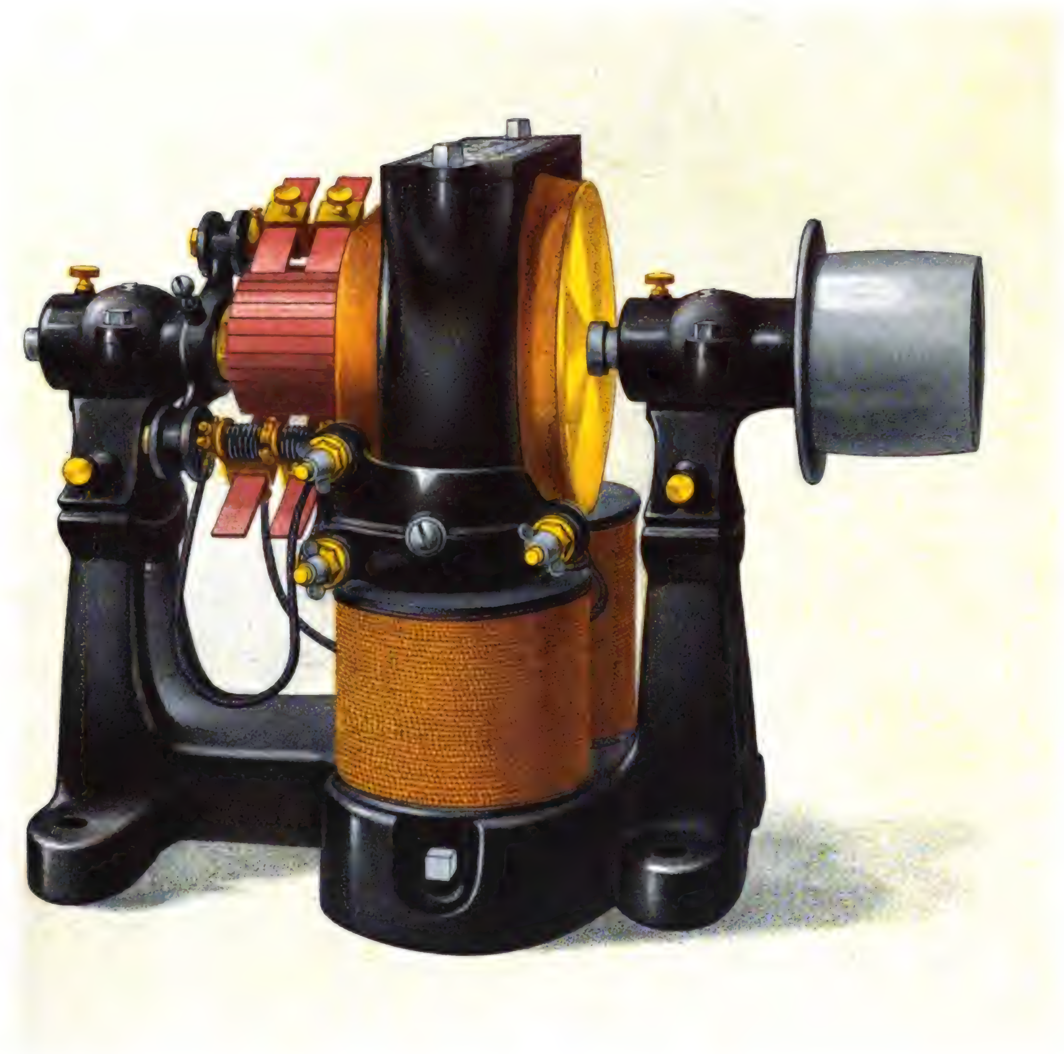
The New York Insulated Wire Company had a full line of samples of their excellent cables, tapes and wires, and were represented by Mr. C. A. Place, Mr. R. E. Gallaher, G. H. Meeker, and J. W. Godfrey, who took care of the delegates in their usual hospitable manner.

STANDARD UNDERGROUND CABLE CO.

The Standard Underground Cable Company, of Pittsburgh, were well represented by Mr. J. W. Marsh, of Pittsburgh, Mr. George L. Wiley, of New York, and Mr. F. E. Degenhart, of Chicago. Such a trio of good fellows could not fail to impress the members, even though they made no attempt to exhibit their cables and wires.

JOHN A. ROEBLING'S SONS.

John A. Roebling's Sons, of Trenton, N. J., did not make any exhibit, but were well represented in the persons of Mr. W. L. Shippey, Mr. W. E. Frick, and Mr. F. A. C. Perrine, who managed to make themselves seen and heard on all sides.



THE CROCKER-WHEELER
PERFECTED ELECTRIC MOTOR.

CONSOLIDATED ELECTRIC STORAGE CO.

The Consolidated Electric Storage Company had an attractive exhibit of their improved storage batteries in a neat oaken case, containing twelve cells. The case was mounted on an oaken table, on which were set a volt meter, ammeter and switch for measuring and manipulating the current. The cells were shown in operation, furnishing current for three 24-volt incandescent lamps, and a small motor. The Chamberlain connector, recently illustrated in the columns of THE ELECTRICAL ENGINEER, was exhibited in use, and the cells were not re-charged throughout the three days, though in constant service. Mr. Wm. Bracken, Mr. P. G. Salom, and Mr. F. H. Deacon represented the Consolidated Company at Cape May.

SIMPLEX ELECTRICAL CO.

The Simplex Electrical Company, of Boston, showed no samples of their wires, but were represented well in the person of Dr. A. F. Mason, the popular general manager of the company; also by Mr. W. H. Gordon, of W. H. Gordon & Co., and Mr. George Cutter, of the Great Western Electric Supply Company.

NEW HAVEN ELECTRIC WIRE CO.

The New Haven Electric Wire Company, of New Haven, Conn., were represented by Mr. C. I. Hague, who did nobly to keep up the reputation of his house, though he made no particular exhibit, saving a few samples of their Helmet Brand wire, which is sold largely through the Empire City Electric Company, of New York.

A. G. DAY'S KERITE.

The old standard insulation, "Kerite," was ably represented at the convention, by Mr. Geo. B. Prescott, Jr., who did not make a large display, but contented himself with the exhibition of a few samples of wires and cables, and the distribution of their new illustrated catalogue and price list.

EDISON GENERAL ELECTRIC CO.

The Edison General Electric Company, of New York, had no exhibit, but were represented by Mr. H. Ward Leonard, Mr. W. H. Fleming, and Mr. J. F. Kelly, the former looking after the general lighting interests, while the latter paid attention to wires and cables.

LEWISOHN BROS.

Lewissohn Brothers, of New York, dealers in copper wire and all kinds of copper goods, were ably represented by our genial and popular friend, Mr. Sam Rosenstamm, of New York, who always contrives to look cool and happy, and shed a cheery ray around him.

THE PERRET MOTORS.

The Elektron Manufacturing Company, of Brooklyn, exhibited one of their well-known and widely used Perret motors, which attracted much attention by its excellence of design and high finish of workmanship. The company also distributed their new pamphlet, in which they discuss the question of low speed, showing how desirable low speed is in dynamos and motors, and illustrating the principles by their own successful practice.

THE NATIONAL CARBON CO.

IN accordance with their excellent custom, the National Carbon Co., of Cleveland, O., represented by Messrs. Crouse, Miles and Smith, distributed copies of their "Directory of Electric Arc Lighting Plants." The new issue, brought down to date of August 1, s a publication of over 100 pages, and in spite of the many difficulties attendant on the task, exhibits every sign of care, completeness and accuracy. The Directory goes by States, and each town and city is given, with its local company or companies, and the name of the system used. The lights are divided into commercial and street lamps, and the total is also given. The list of private or isolated plants is also thorough, and thus one is able to see at a glance just how many arc lights are in use in any one town and to figure on the demand for supplies or the prospects of increasing the local capacity. The National Carbon Co. are well known throughout North and South America as makers of carbons, and are supplying Brush, Thomson-Houston, Western Electric, American, Ball, Reliance, Schuyler, Sperry, Wood, Excelsior, United States, Fort Wayne and other plants with their molded and forced carbons. They are now also developing a large trade in carbon brushes for dynamos and motors, and in carbon plates and shapes for every class of electrical work.

JEWELL BELTING COMPANY.

Mr. C. L. Tolles, on behalf of the Jewell Belting Co., of Hartford, Conn., exhibited in his rooms a number of fine specimens of their belting, of the kind in use in a number of electric light plants.

PASS & SEYMOUR.

The above concern were represented by Mr. Seymour, himself a central station man and familiar with the requirements of the work. They have gone into the production of electrical chinaware at Syracuse, N. Y., and the productions shown are certainly such as to secure for them a large share of business. Their goods show the signs of thorough vitrification, and are of great strength, fine color and exquisite finish. Their plant is specially designed for this class of work, and their machine shop is fully equipped for die making, so that in these and other electrical novelties, a line of which they are now getting together, they bid fair to build up a large trade.

THE WESTERN POWER CONSTRUCTION CO.

One of the leading Western visitors to the convention was Mr. W. P. Adams, the general manager of the Western Power Construction Co., of the Rookery, Chicago, which has lately been cutting such a wide swathe in the equipment of electric light and power plants. The company represent the McIntosh & Seymour engines in a large territory, and since their recent organization have done an enormous business.

ABENDROTH & ROOT MANUFACTURING CO.

The above company, of 28 Cliff street, this city, were admirably represented by their very handsome pamphlet, in which are set forth the various features of their well-known water tube Root boilers. This pamphlet, replete with illustrations and descriptive text, was accompanied by two others on the same subject, one giving the sizes and dimensions and the other giving a partial list of some of the firms using the boilers.

CONVENTION NOTES.

JAMES W. QUEEN & COMPANY made an interesting exhibit of their high class instruments, including galvanometers, resistance boxes, testing sets. A portable photometer and a resistance box of one megohm attracted considerable attention.

THE BRADY MAST ARM COMPANY, of New Britain, Conn, were represented by Mr. T. W. Brady, who is well known as a reliable manufacturer of mast arms, lamp hoods, etc.

THE NATIONAL CONDUIT MANUFACTURING COMPANY had Mr. J. P. McQuade, of New York, looking after their interests.

THE D. M. STEWARD MANUFACTURING COMPANY, of Chattanooga, Tenn., manufacturers of lava electric insulators, and insulating material for all electric purposes, were represented by Mr. D. M. Steward, the president of the company. The business of this company is increasing very rapidly, and they are making large additions to their productive facilities.

THE EASTERN ELECTRIC CABLE COMPANY, of Boston, were represented by Mr. H. H. Eustis, of Boston. No exhibit was made.

PETTINGELL, ANDREWS COMPANY, Boston, were represented by Mr. F. E. Pettingill, who is just as energetic as ever, and as well informed on every new development of the business.

THE ELECTRIC GAS LIGHTING COMPANY, of Boston, had no exhibit but had their indefatigable general manager, Col. Louis W. Burnham, on the ground to meet his friends, whose name is legion. Col. Burnham has always a "battery" of good humor at his disposal, as inexhaustible as the "Samson," and manages to enjoy himself and make others enjoy themselves wherever he goes.

THE E. S. GREELEY COMPANY did not make any exhibit, but sent Mr. Frank A. Magee to look after their interests, which he did with his usual good nature and thoroughness.

CHAS. A. SCHIEREN & COMPANY were represented by Mr. G. H. Fisher and Mr. E. P. Atkinson, who discussed the merits of Schieren belting.

THE MOORE & WHITE COMPANY, of Philadelphia, Pa., manufacturers of Friction Clutch Pulleys, Cut-off Couplings, etc., were represented by W. H. Shoemaker, who also looked after the interests of the Main Belting Company, of Philadelphia, manufacturers of the Leviathan Belting.

THE CROSBY ELECTRIC CO. made an exhibit of the new dry battery they control, recently brought out by Mr. J. H. Van Gestel, who was himself present to describe its features and merits.

THE STANDARD PAINT CO. made an exhibit in a quiet way of their P. & B. paints, insulating compounds, varnish for armatures, etc., insulating papers and other specialties. They were represented by President Ralph Shainwald and Mr. W. W. Castle.

THE CONSOLIDATED FRUIT JAR CO. was represented by Mr. F. P. Wisner. The company is making a specialty of fuse wire, and a number of metallic parts required in electrical work.

THE PUMPELLY STORAGE BATTERY CO. distributed a neat little pamphlet, giving information as to their storage batteries, now being used quite extensively in electric light work.

THE WALSH GASOLINE TORCH CO., of Chicago, distributed a quantity of reading matter in regard to their torch for linemen, the features of which were described in a recent number of THE ELECTRICAY ENGINEER.

WM. BARAGWANATH & SON, the well-known builders of steam apparatus at Chicago, distributed illustrations of their feedwater heaters, purifiers, boilers, &c.

THE CHICAGO FIRE-PROOFING CO. exhibited samples of its mineral wool insulation for covering steam pipes and boilers, and the data in regard to same was set forth in print for general circulation.

THE NUBIAN IRON ENAMEL CO. has found a market for its specialty in the electrical field, as a coating for arc lamps; and on this occasion it issued a fac simile of the letter from Supt. E. F. Peck, recommending its use.

THE SENSIBLE AUTOMATIC PACKING CO., of Chicago, had for circulation an extremely pretty little circular, the cover of which was as novel as the inside reading was pithy and pertinent. This specialty is a flax packing, with a pure Para rubber core and a wax lubricant, "made upon honor."

THE MUNSON BELTING CO. were out in force, despite the distance from Chicago, being represented by Vice-President Groetzinger, Col. J.H. Shay, who was also accompanied by his brother, Mr. J. W. Shay, and the New York agent, Mr. Gabel. They did not leave without doing some excellent business.

THE WESTERN ELECTRIC CO., of Chicago and New York, were represented by Mr. Chas. A. Brown, who, from his active participation in the affairs of the Association, and his interest in electric lighting generally, finds that conventions are times of but scant leisure.

THE CENTRAL ELECTRIC CO. were ably and adequately represented by Mr. Geo. A. McKinlock, who has availed himself of his visit East to carry on one or two business negotiations of magnitude and importance.

J. J. RYAN & CO., brass founders and finishers, of Chicago, issued a neat type-written circular calling attention to the facilities of their brass foundry for electrical work. They have 32 furnaces, a smelting capacity of 10,000 lbs. of brass per day, room for 40 moulders, and floor space of 20,000 square feet.

THE PARKER-RUSSELL CO., of St. Louis, makers of carbons, were represented very successfully by Mr. D. R. Russell, who rarely, if ever, misses a Convention.

THE FORT WAYNE ELECTRIC CO. were represented by Messrs. Slattery, Morrison and Wilbur.

THE BRIDGEPORT BRASS CO. was represented by Mr. H. D. Stanley.

MR. C. O. BAKER, JR., represented the platinum interests in the Convention halls.

THE CHALMERS-SPENCE CO. distributed pamphlets in regard to the asbestos manufactures.

THE C. & C. MOTOR CO. were represented by Messrs. Lufkin & Hall. The paper by the former, printed in this issue, was one of the most interesting and valuable ever brought before the Association.

THE GREAT WESTERN ELECTRIC SUPPLY CO. was ably represented by Mr. Geo. Cutter himself, who found so many interested in the new enterprise he is pushing forward into leadership so magnificently that he got little time for social occupations and relaxations. It is whispered that Mr. Cutter found opportunity to perfect some of his arrangements for the extension of his company's business, and that he has already made his arrangements with the Union Electric Co., of Pittsburgh, as an Eastern branch.

HOLMES, BOOTH & HAYDENS put their best foot forward in Mr. Theo. Larbig, who has charge of their electrical sales.

MR. L. W. SERRELL, JR., was present, not only in his own behalf as engineer and expert, but to represent the Milliken pole, of which he has already sold several thousand in the new field of railway electrical work.

THE E. P. GLEASON MANUFACTURING CO., who make so large a line of electrical fixture specialties, glassware, etc., were represented by Mr. W. F. Cullen, who has been present at so many meetings.

MR. C. S. VAN NUIS, the builder of heavy current switches, was on the ground to explain the peculiar felicity of their name. The article in THE ELECTRICAL ENGINEER of August 20 served him as an excellent basis for a talk on the merits of the "Ajax."

THE AMERICAN ELECTRICAL WORKS sent Mr. P. C. Ackerman to represent them.

MR. C. R. VINCENT was present to answer for his firm and for the Ball engine.

THE FIELD ENGINEERING CO. were represented by Mr. C. J. Field, who had snatched a day or two from his pressing engagements elsewhere in Jersey to take a brief spell of leisure at the Cape.

THE EMPIRE CITY ELECTRIC CO. sent to the front their president, Gen. O. E. Madden, who, it is needless to say, was a leader in all the festivities as well as business proceedings of the occasion.

THE THOMPSON-HOUSTON CO., while it was strangely and sadly without representatives from its Eastern end of the line, owing to the terrific rush of business, found a good spokesman in Mr. H. H. Small, from Chicago, and Mr. W. F. Davidson, from Michigan.

MR. A. F. MOORE was on hand to represent his well-known wires. He has just brought out a most admirable and complete catalogue of his manufactures.

H. A. CLEVERLY, of the Cleverly Electrical Works, found no difficulty in coming on from Philadelphia, and talking motors and kindred topics.

THE FOREST CITY ELECTRIC WORKS were represented by Mr. W. B. Cleveland, of switch and cut-out fame. Mr. Cleveland had a new lamp hanger to bring to notice.

THE BRUSH ELECTRIC CO. sent Mr. C. C. Curtis, of Cleveland, as their representative.

CLOWER & HARRIS were represented by Mr. D. M. Clower, a good type from Dallas, Tex., of the spirit that animates the New South.

THE SHULTZ BELTING CO. were represented by Mr. A. B. Laurence, who showed a full line of the Shultz belting and pulley covering specialties.

THE EDDY ELECTRIC MOTOR CO. were represented by Messrs. Baird, Newton and McIntire.

THE METROPOLITAN RUBBER CO. were represented by Mr. C. A. Place, president, and Mr. Geo. H. Meeker, showing their cheap hard rubber tube for insulating purposes. The company also make rubber gloves for linemen.

THE ILLINOIS ELECTRIC MATERIAL CO., of Chicago, who handle the Bishop wires and cables and other specialties, and are making a fine record as a new concern, were well represented by their energetic young president, Mr. H. S. Winston, who was unfortunately called away suddenly, to close up a large business deal.

LITTLE, MCDONALD & CO., the electrical engineers and supply agents of Buffalo, were represented by Mr. W. H. McDonald.

THE WM. POWELL CO., of Cincinnati, O.—Mr. James Powell, who represented this company at Cape May, showed a fine line of samples of lubricating devices for all purposes. Among these was the Powell patent improved signal oiler. In this device the flow of oil can be instantly stopped or started without changing the feed, as the operation of the signal lever is independent of the feed regulator. The filling hole on the top cap is covered by the Powell patent snap lever, which can be readily moved either side to expose the hole. Their triple and double dynamo sight feed oil cups embody the same principles and are admirably constructed.

FINANCIAL MARKET.

QUOTATIONS ON ELECTRICAL STOCKS.

Mr. F. Z. Maguire, Electrical Securities, of 18 Wall street, this city, reports the following quotations of August 23 from New York, Boston and Washington :—

NEW YORK.

	BID.		BID.
W. U. Tel. Co	82¼	Edison Gen. Elec. Co	102
American Tele. & Cable	88	Edison Gen. Co. Def'd	90
Centl. & So. Amer	157	Conso'd Elec. Lt. Co	60
Mexican	205	Edison Illn'g Co. N. Y.	....
Com. Cable Co	....	U. S. Elec. Lt. Co	35
Postal Tel. Cable	85	North. Am. Phon'gph	65

BOSTON.

	BID.		BID.
Thomson-Houston	50¼	Ft. Wayne Co	12
" Pref'd.	25¼	Am. Bell	223
" Series C	....	Erie	50¼
" " D	6¼	New England	50
" Int. Co	....	Mexican	.85 cts
Thomson Welding Co	..	Trop. American	..
Thomson Eu. Welding	89	Edison Phon'gph Doll	2¼

*Ex. Dividend.

WASHINGTON.

	BID.		BID.
Penna. Telephone	25	U. S. Elec. Lt. (Wash)	140
Ches & Pot. Telephone	75*	Eck. & Sold. Home Elec. Ry	 66
Amer Graphophone	14		

*Ex. Dividend.

PITTSBURGH.

	BID.
Westinghouse Electric Manufacturing Co	38

ANNUAL CLAMBAKE OF THE AMERICAN ELECTRICAL WORKS.

THE Saturday following the Summer Convention of the National Electric Light Association has for some years past been a "red letter" day with members of the national fraternity from all parts of the country. On that day the American Electrical Works, of Providence, have been accustomed to give their Annual Clambake, and all who can possibly attend have been wont to hie to the Vue de l'Eau Club, and bury the hatchet of business competition and join with Messrs. Phillips and Sawyer in having a royal good time. Last Saturday was no exception to the rule, and about 160 gentlemen enjoyed the hospitality of Mr. Phillips and talked over old times while they "wrestled" with the festive and succulent clam. A large number went down from New York on the Providence boat on Friday night, and quite a large contingent traveled over from Boston on the nine o'clock train. All joined forces on the eleven o'clock boat from Providence to the Vue de l'Eau Club, where the usual lunch and bowl of Phillips' punch was awaiting them. Tall white hats and silk hats received the usual careful attention, and the more inexperienced of the guests were warned at the outset by someone pointing out the tattered remains of Mr. Fred. Gilbert's hat of past years, which was still decorating the top of a sixty-foot telegraph pole, where it had been set with all honors by some daring and agile member.

The New York and Boston members soon engaged in a friendly game of baseball, in which Boston came out with flying colors, having defeated New York by 28 to 23, with 7 home runs. The weather, though a little unpropitious in the morning, brightened up wonderfully, and everyone had a good time. The usual foot-ball was there, which got in some excellent work on the hats and heads of the unsuspecting. Opportunities were also afforded for testing one's expertness with the rifle, or his strength with the sledge-hammer, or even one's lung capacity, by blowing into a recording machine. At 3 o'clock the dinner commenced, after a speech of welcome from Mr. Geo. S. Bowen, father of the National Electric Light Association, and as an interesting memento of the occasion, coupled with a desire, doubtless, on the part of Messrs. Phillips & Sawyer, to make Rome howl (speaking classically), every one was provided with the latest musical novelty unearthed by Stanley from the darkest and most uncivilized part of the dark Continent, appropriately termed a "Squawkophone." These instruments bear a strong resemblance to what in happy childhood's day we termed a "devil's fiddle;" anyhow, they did undoubtedly make that kind of noise. Valuable instructions, together with a complete history of the wonderful discovery of this instrument of torture in the backwoods of Africa (please do not confound these with the suburbs of Providence), were enclosed in each squawkophone. The menu, as usual, was excellent. After dinner Mr. O. E. Madden officiated as "toast master," and introduced the various speakers, who all spoke briefly and to the point. The toasts and speakers were as follows:

1. Eugene F. Phillips, President Americen Electrical Works; our host and everybody's friend. E. F. PHILLIPS.
2. The Rhode Island Clam, the juiciest of the juicy; evidently of ancient origin, being represented in the Vulgate by the sixteenth letter of the alphabet. J. M. ADDEMAN.
3. The Telegraph; the first practical application of electricity by a modest old timer. SUEL SMITH.
4. The Telephone; speechless, yet master of all languages; there is no discount on this or on the rates; will be responded to by one who got in early. H. L. STORKE.
5. Electric Light and Power; safe, reliable, economical and adapted to all uses except electrocution. MARSDEN J. PERRY.
6. The Electrical Press; to our faults a little blind; to our virtues ever kind. T. C. MARTIN.

Other gentlemen were also called upon.

Three cheers and a tiger were then given for Mr. Phillips, and the twelfth clam bake, of 1890 was at an end, most of the gentlemen returning by the 5:40 boat to Providence, where they separated for their various destinations.

THE GREAT WESTERN ELECTRIC SUPPLY CO.

The Great Western Electric Supply Co. have got in a large invoice of telegraph apparatus and their "learners' outfits" are already being rapidly disposed of. They have several other large lots on the way and expect to control a good part of the Western business in telegraph apparatus. They are also selling large quantities of the Samsom batteries, which have heretofore been better known in the East than in the West. Their catalogue is expected out this week. That so young a firm should put out a complete and well-rounded catalogue in so short a time is a practicable impossibility, hence the firm, with their keen foresight of the requisites and possibilities of a full-fledged price list, have called this forerunner its "sketch-catalogue." Still our readers will not find much of the sketchy about what it offers, as all the standard supplies and specialties mentioned in it have been carefully worked out.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

JAMES H. MASON'S PRIMARY BATTERIES.

It is not alone in this country but abroad that Mr. Mason's primary batteries have won their way to favor and popularity. He is now enlarging his factory to double its size, at 118 and 120 Park avenue, Brooklyn, in order to meet the demand, and has lately been running night and day. Among his recent orders are one from Jamaica, West Indies, and another from Bengal, East Indies.

WESTERN TRADE NOTES.

THE ELECTRIC MERCHANDISE COMPANY, 11 East Adams street, Chicago, have been appointed agents for the Calorific Ventilating Heater Company, of Mansfield, O., manufacturers of Calorific Ventilating Heaters for street cars. This method of heating, and at the same time ventilating, street cars has met with great success, and has been largely adopted by street railway men all over the country. Mr. Mason, the general manager of the company, reports business as rushing and orders coming in all the time. They devote their undivided attention exclusively to the manufacture and sale of electric street railway supplies and specialties for all systems, and the advent of a concern handling these lines of goods alone has received the hearty commendation and patronage of the various electric street railway companies.

"WHITE CORE."—The well-known Bishop gutta percha white core wire is being used by the United States Electric Lighting Company in wiring the building of the Domestic Sewing Machine Company on Wabash avenue and Jackson street. The Illinois Electric Material Company are the general Western agents for these wires and cables.

NEW ENGLAND TRADE NOTES.

THE NEW ENGLAND WIRING AND CONSTRUCTION CO. have received the contract to wire the Master Builders' Association building on Devonshire street, Boston, for about 600 lights. Interior conduit will be used.

THE ELECTRIC GAS LIGHTING CO. have in their store ready for shipment to a hotel in Concord, N. H., a very handsome Tirrell drop annunciator, 3 ft. 6 in. wide by 4 ft. 6 in. high, made of quartered oak, and finished in their best style. The annunciator will accomodate from 125 to 150 rooms, and reflects credit on the builders.

THE STANDARD ELECTRIC CO., OF VERMONT, have recently made the following sales of electric light apparatus: The National Needle Company, Springfield, Mass., 300 light plant; Ashley & Bayley, Patterson, N. J., 500 light plant; The Cordis Mills, Milbury, Mass., 300 light plant; and the Republican Press Association, Concord, N. H., 300 light plant. The Standard Company are gradually making a reputation for their dynamos as a reliable and slow speed machine of minimum weight.

THE WAINWRIGHT MANUFACTURING CO., OF MASSACHUSETTS, have sold a 700 horse power heater to the New Bedford Gas Light Company, New Bedford, Mass.; a 300 horse power heater to the Clinton Electric Light Company; a 75 horse power heater to the Westinghouse Electric Light Company at Ogden, O.; and an 80 and a 30 horse power heater to the Ball Engine Company, of New York.

THE RICE AUTOMATIC COMPOUND ENGINE.

WE illustrate herewith two of the newest types of tandem compound engines, built by the John T. Noye Manufacturing Company, Buffalo, N. Y., under the patents of Mr. F. B. Rice, the well-known engineer. Fig. 1 represents an engine for duties up to 100-horse power, and Fig. 2 a larger one, designed for heavy loads. In the former the frame is of the same form as that used for the standard simple Rice engines, and can be made self-contained or with outside bearing, to suit special local requirements. The governor is inside the crank disc, and operates automatically the high and the low pressure valve. Either of these valves can be set independently of the other, while the engine is in motion, and both are balanced for all pressure higher than the exhaust.

It has been demonstrated that, with a full head of steam on, both valves can be moved by the pressure of two fingers on the valve stem. The valves take steam from the inside, so that, if it is desired to ascertain whether they are tight, they can be operated with the chest-cover off. The patented pressure plate, of Mr. Rice's design, forms a valve for the escape of water and for relieving over-pressure in the cylinders. The lubrication has been made as nearly perfect as possible; every oil-cup is stationary, and provided with sight feed and adjustable cut-off.

The compactness, smooth running, and high economy of this engine have strongly commended it to electric light companies,

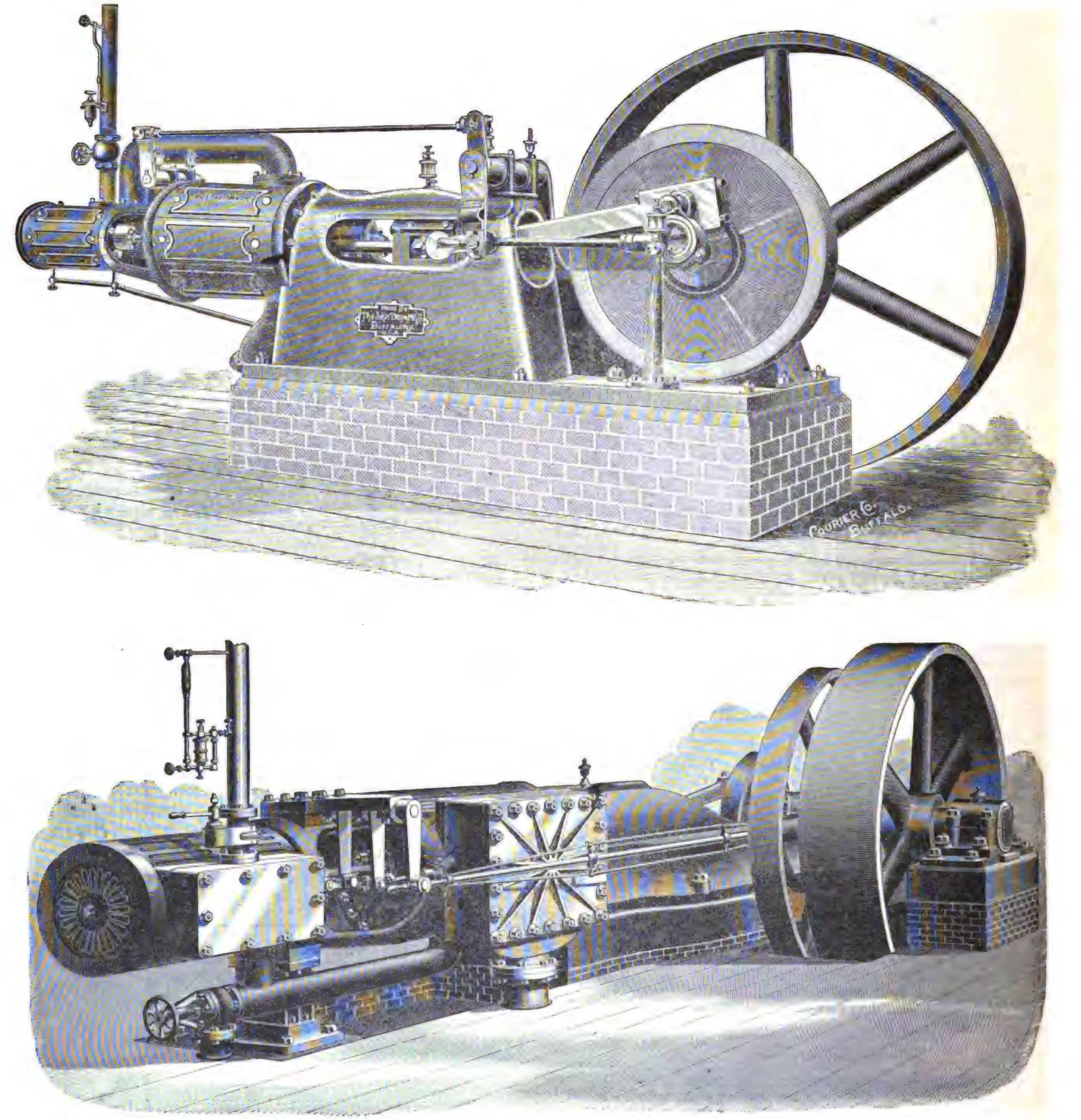
among whom it is already in extensive use. For mills and factories it has also proved to be highly desirable.

The heavy-duty Rice engine, represented in Fig. 2, as seen from the rear, shows clearly the valve motion and the governor, as well as the cylinders and frame.

The reader will note the low and unusually heavy frame, which is about twenty-five per cent. heavier than that of the standard engine. The increase in mass, however, has not been allowed to detract from the looks of the engine, but is distributed with such nice judgment so as to give it an appearance of graceful solidity to please the eye.

With two exceptions, frame and governor, this heavy-duty Rice engine is practically identical in construction with the standard tandem compound engine described above. The crank disc being too small for the governing mechanism required on so large an engine, it has been found best to place the governor in the fly-wheel, or, in some cases, in a wheel of its own. The valve is then driven from a separate eccentric on the shaft; both valves being driven automatically by the governor. The valve itself is of the well-known gridiron pattern, with four ports, and is so nicely balanced that it can easily be operated by hand, even when under full steam pressure.

The main bearing is provided with quarter boxes, in order that the wear may be taken up in any or all directions. These boxes are lined with genuine Babbitt metal, and then bored out to a perfect fit. The connecting-rod is of forged steel, with a loop to contain the brasses for the crank-pin. This construction is more costly than that in the standard engine, but is warranted by the additional safety and strength which it gives. The crosshead has a suitable take up for wear, and is so arranged that it cannot be tightened to the point of cutting. Engineers will particularly appreciate the fact that in this engine the low-pressure piston head can be removed without disconnecting the high-pressure, and of the arrangement by which steam may be used in either cylinder without employing the other. Thus, if the water supply becomes scant, making the condenser unavailable, the high-pressure cylinder may be used alone, giving three-fourths of the engine's full capacity.



FIGS. 1 AND 2.—THE RICE AUTOMATIC COMPOUND ENGINES.

Great weight and solidity, few and simple parts, high fuel economy, adaptability for long runs, large wearing surfaces, smallest safe clearance, and a regulation so sensitive as to keep at less than one per cent. the variation from full load to no load, are among the points which contribute to the success of this new type of engine.

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New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.
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EDITORIAL ANNOUNCEMENTS

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

VOL. X. NEW YORK, SEPTEMBER 3, 1890. No. 122

The laws of Nature are the thoughts of God.—Oersted.

ELECTRIC RAPID TRANSIT IN CITIES.

SOME very interesting information has just been issued by the Census Bureau, in a bulletin of which Prof. H. C. Adams is the author, giving statistics as to the rapid transit facilities in this country in cities of over 50,000 inhabitants. There are about fifty such cities. We append two tables containing the data :

Year.	Total mileage.	Increase. Miles.	Increase. Per ct.
1880	1,689.54		
1881	1,765.95	76.41	4.52
1882	1,875.10	109.15	6.18
1883	1,941.49	66.39	3.54
1884	2,051.84	90.35	4.65
1885	2,149.66	117.82	5.80
1886	2,289.91	140.25	6.52
1887	2,597.16	307.25	13.42
1888	2,854.94	257.78	9.93
1889	3,150.93	295.99	10.37
Total		1,461.39	86.50

The per cent. of total mileage of fifty-six principal cities operated by various kinds of motive power was :—

	Miles.	Per cent.
Animal power	2,351.10	74.62
Electricity	260.36	8.26
Cable	255.87	8.12
Steam (elevated roads)	61.79	1.96
Steam (surface roads)	221.81	7.04
Total	3,150.93	100.00

The length of line assigned to each of the five leading cities in 1889 was as follows :—Philadelphia, 283.47 miles ; Boston, 200.86 ; Chicago, 184.78 ; New York, 177.10 ; Brooklyn, 164.44. The number of miles assigned to each city is as follows :—New York, 368.62 ; Chicago, 365.50 ; Boston, 329.47 ; Brooklyn, 324.63 ; Philadelphia, 324.21.

The apparent preponderance of Brooklyn and Philadelphia is explained by the fact that in those cities the roads are often single track, going out on one street and returning by another. New York, for example, has 161 miles of double-track road and Philadelphia only 39.

But the main point of interest is the relation between electricity and the other motive powers. The figures above show that in 56 leading cities it is only 8.26 per cent. —a respectable figure, it is true, but still small. On the other hand, the figures for the whole country, as we had occasion to prove recently, are very different. They run thus:—

Miles of horse railway,	5,902½
" " electric "	1,753
" " dummy "	556
Cable,	441
Total mileage,	8,652½
Number of electric roads,	264
" " cable "	44

Here, it is seen, electricity is more than 25 per cent. already of the total mileage. It is also more than 25 per cent. of the total number of roads, there being nearly 1,000 in all, but only 807 in independent operation.

The question arises : How shall the proportion of electrical operation in the cities be brought up to that of the country as a whole? Will it be by means of the overhead system? We doubt very much if it will be through the latter agency. In some cities, such as Boston and Minneapolis, the prejudice has been overcome, but elsewhere it is still as invincible as ever. This leaves the field to the storage battery, unless an elevated track be erected ; or unless a good conduit system is forthcoming. But where shall we find a good conduit system to-day ?

NEW WORK IN THERMO-ELECTRICITY.

THOSE who study the signs of the times cannot fail to be impressed with the efforts which are now being put forth in many directions to bring within the range of commercial practicability the thermopile. Though known for more than half a century, this form of electric generator has not yet emerged from the laboratory of the experimenter, except in its application to a few special forms of work where its great convenience has put it before the voltaic cell, as a working apparatus. The acknowledged low efficiency of the thermopile must, no doubt, be looked to as the cause of the backward state in which it has up to recent times been allowed to remain ; but the energy with which the problem is now being attacked leads us to believe that the near future may place this form of electric generator in a position of considerable importance. The direction in which a number of inventors are working at the present hour is pointed out in an article appearing on another page, from which it will be evident that the combination of a few dozen elements heretofore employed is giving place to a series embodying thousands of elements and heated by furnaces of large dimensions. The special methods adopted are also worthy of notice. Thus, Mr. Edison seeks to obtain an increased effect by constantly renewing the surface of contact of the two elements, by transferring the heated portion of one element to a relatively cooler point. This he accomplishes by employing as one of the elements a revolving disc. Mr. Cox, on the

other hand, has introduced a novel principle of construction, effecting what he terms a fall in thermic potential.

The extent to which these and similar modifications improve the working capacity of the thermopile remains to be determined, but enough has been said to show that the interest in this old method of generating electricity has been remarkably renewed. Whether or not, the thermopile in its modifications will realize the expectations of those who look to the universal generation of current direct from coal, we will not undertake to say, but the subject is certainly of sufficient interest to warrant the most attentive study and most exhaustive experiment. The steam engine and the dynamo are a combination which it may take a long time to supersede but the victory of the dynamo over the voltaic battery was not accomplished in a day nor without the expenditure of many weary years of toil and thought and outlay.

FAN MOTORS FOR WINTER SERVICE.

As far as our observation goes, the tendency is pretty general among central station managers to regard the electric fan business as one that belongs peculiarly to the summer time and is killed off by the first frost. Such an idea seems to us to be without foundation. We believe that there is work, and plenty of it, for fan motors the year around. In fact, they who have enjoyed their cooling breezes during the dogdays are not likely to be ungrateful or of short memory when the wearisome months of stuffy heat and slow suffocation come again. If you make mankind happy now, said Sydney Smith, you make them happy twenty years hence by the recollection of it; but it is natural and human not to dwell simply in recollections, but to enjoy, if possible, a renewal of pleasurable sensations. Our many central station readers will confer new benefits on the public by pushing the fan motor industry as well during January as in July; and they can render many a meeting hall, ball room, school room or office fitter for occupancy and use. We do not see why the little motors could not also be attached to ozone generators and thus not only agitate the air but freshen and purify it directly.

A NEW CONSTRUCTION IN ELECTRIC GENERATORS.

While the number of methods of generating an electric current actually employed in practice is very limited, the number of possible ones is quite large. A most interesting addition to the latter is that which we describe in another column, and is due to Mr. Edison. He has taken up for investigation the irresistible force exerted by the expansion of bodies due to heating. As in his thermo-magnetic generator, Mr. Edison employs nickel as the metal subjected to the heat, on account of its non-corroding properties. While this is undoubtedly a most ingenious combination, it is hardly likely that the new generator will become commercially practicable. The effect obtainable by the rupture of the magnetic circuit to the extent described must obviously be of comparatively small amount, and to this must be added the fact that the rate at which the makes and breaks can be obtained is limited by the rate at which the expanding metal can be heated and cooled so as to give the desired expansion. Nevertheless, the method pointed out will prove of interest as showing another of the many ways in which heat can be applied to the generation of current.

Earth Polarization by Electric Railways.

The further investigations of Mr. Cuttriss into the nature of the disturbance which has affected the Commercial cable running parallel with the Coney Island Electric Railway has disclosed an interesting fact, demonstrating the action of the current on the earth in the vicinity of the rails. It is natural to expect that, with a ground return, the earth would be polarized, and under favorable conditions gas would be generated by electrolytic action, and would by preference be spread out over a large area of ground. As Mr. Cuttriss' experiments prove, the increase of the potential between New York and Coney Island, due to these independent and variable currents set up between the rails and the sheathing of the conductor, is sufficient to explain the phenomena observed. According to Mr. Cuttriss, therefore, we have here to deal with earth current phenomena rather than with direct dynamic induction, and hence the means to be adopted to avoid the disturbance at once assume a more troublesome aspect. As pointed out, relief might be obtained by a return cable identical in every respect with the main cable, a condition which, of course, is exceedingly difficult to fulfill.

A Novel Telephonic Reaction.

We have recently had our attention called to an interesting phenomenon in connection with the telephone, which might be looked upon with suspicion by the uninitiated. While Messrs. Hibbard and Pickernell were conversing recently over one of the lines of the Long Distance Telephone Co., the former, in order to shut out some conversation, placed the receiver with the diaphragm end over the mouth-piece of the long distance transmitter. The receivers at both ends at once began to give out a musical sound, which continued until the receiver was withdrawn from the mouthpiece of the transmitter. Investigation proved that the effect was due to an action quite similar to that employed in the well-known buzzer or vibrating bell. An original impulse imparted to the transmitter is conveyed electrically through the primary and secondary circuits to the receiver, which in turn throws it back upon the transmitter through the intervening air, thus constituting a complete electric and acoustic cycle. This battledore and shuttlecock action between receiver and transmitter is continuous as long as the receiver is held against the transmitter, and gives rise to a musical note of high pitch and great uniformity. Of course it requires a powerful transmitter to produce the phenomenon, the ordinary Blake instrument being incapable of demonstrating it. The effect produced is decidedly novel and the experiment is well worthy of repetition.

Arc Light Carbon Manufacture.

The news from Cleveland published in our columns this week, as to a consolidation of arc light carbon industries there, is interesting. It will be noted that the plan proposed will, according to these reports, place a large proportion of the carbon factories under one management. Efforts to do this have been made before, of one kind and another, but this is the first to look like definite success.

POLARIZATION OF THE EARTH BY HEAVY CURRENTS.

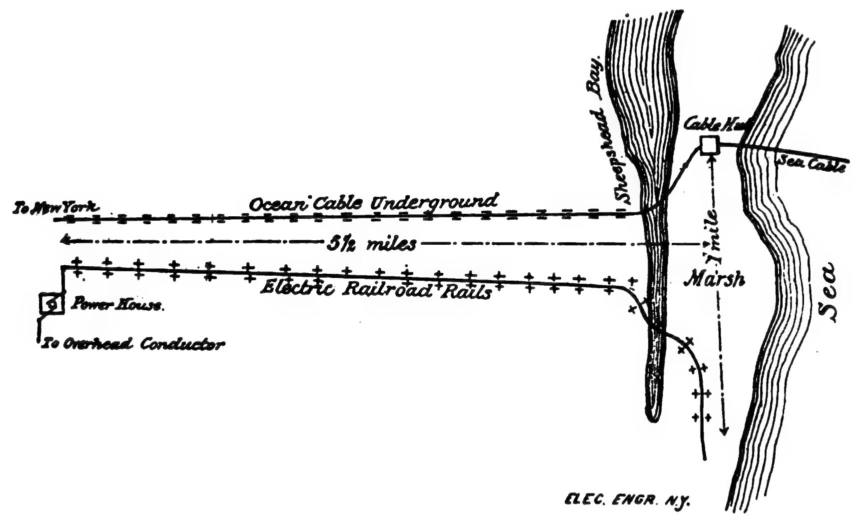
BY CHARLES CUTTRISS.

WHILE investigating further the causes of the disturbances experienced when testing the Commercial Cable Co.'s cable which lands at Coney Island, an account of which will be found in the THE ELECTRICAL ENGINEER of Aug. 6, certain phenomena have been noticed which may be interesting as showing the effect of heavy currents in polarizing the ground when it is used as a return circuit for an electric road, and also the great distance at which such effects are felt.

On Sunday, Aug. 17, an attempt was made from my office in the Drexel building, New York, to take the usual weekly test of the condition of the cable, but without success, as, owing to the violent and erratic movements of the mirror, it was impossible to get a reliable reading. It was then determined to measure, if possible, the differences of potential that caused such disturbances. In order to make the method of procedure clear, it will be well to state that the underground circuits of the company extend from Wall street in a northerly direction to the Bronx river, a distance of about 12 miles and in a southerly direction to Coney Island, also about 12 miles. As there is nothing to my knowlege in the vicinity of the Bronx river terminus to cause any electrical disturbance of the earth's potential, the grounding at that station and at Coney Island of one of their wires gives a very ready way of detecting in New York any variations of potential that may take place at either end.

The first series of experiments were made between the hours of 10:45 a. m., and noon of August 17, and showed that between Bronx river and New York there was a fairly steady difference of potential of from .8 to 1 volt; but between New York and Coney Island there was a difference of potential varying rapidly from .1 to 3.5 volts, the extreme fluctuations often occurring in 4 or 5 seconds. The potential difference between Bronx river and Coney Island was about the same as between New York and Coney Island, or perhaps a trifle higher, and also very unsteady.

It was useless to do anything more until the electric road closed down, so the experiments were abandoned till midnight. At 12:25 a. m. I found a very heavy current between Coney Island and New York, but could not detect the running of any cars. Measurements now showed a positive difference of potential of 4.5 volts; this remained fairly steady till about 1 a. m., when the potential commenced to fall slowly and steadily. At 1:15 a. m. the galvanometer denoted an equal potential at both ends of the line, but the movement of the mirror still continued, slowly crossing the zero and indicating an opposite, or negative, potential wave, which by 1:25 a. m. had reached 3.5 volts negative. It then began to drop, reaching zero at 1:40 a. m., and continued on until it showed a positive difference of .8 volt, where it remained steady, showing that the earth at Coney Island had become normal, as the difference of .8 volt corresponded with the reading between New York and Bronx river. I might state that the New York ground potential was checked off by the Bronx river circuit every five minutes in order to make sure that the variations were not due to local causes.



EARTH POLARIZATION DUE TO ELECTRIC RAILWAYS.

From the results obtained in the above experiments it is quite evident that there is an actual polarization of the ground for an unknown distance from the rails of the electric road. The accompanying diagram will make clear the relative positions of the electric road and the ocean cable. The first long, positive (+) current, I think, must be caused by a direct flow of current from the rails through the sea and across the marsh and Sheepshead Bay to the sheathing of the cable; consequently when the current is cut off from the rails this direct current gradually drops, and as the current due to the polarization asserts itself, for an instant the ground at the point of connection between the conductor and sheathing becomes neutral from the action of equal and opposite forces. But, as the negative current from the ground surrounding the cable discharges along the sheathing, that being the path of least resistance, it produces a negative potential at the end of the conduc-

tor, which rises to a maximum in a few minutes and then gradually dies away as the condition of the ground becomes normal. If the normal condition of the ground can thus be raised 4.3 volts by a disturbing force at a distance of ½ mile, the close proximity of these two systems would certainly render the practical working of the weaker one—the cable—almost an impossibility, even if, as suggested by Mr. T. D. Lockwood, a duplicate cable were to be laid, as it is mechanically impracticable to construct two cables in which the dielectric resistance, copper resistance, and capacity shall be identical. Consequently, a variation in either of these respects must make itself manifest when the cores are subjected for a considerable distance to violent and rapid electrical strains.

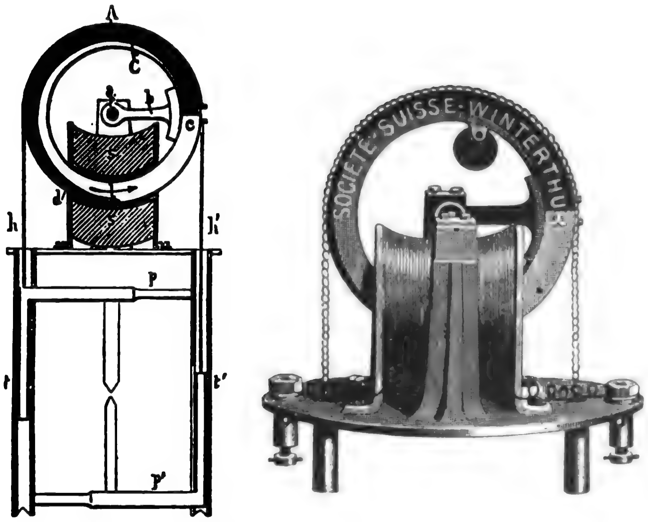
The great difference in this problem over that of equalizing telephone or telegraph circuits rests in the extreme delicacy of the receiving apparatus, and the enormous electro-static capacity of long lengths of submarine cable.

THE ZWEIFEL ARC LAMP.[1]

DURING late years such a variety of arc lamps have been described that it is very difficult to find any novelty in the designs that still rise to the surface every day.

Among the different apparatus exhibited last year in the Machinery Hall, at the Exhibition, a lamp was noticed, not lacking in originality, and which is certainly one of the most simple regulators yet devised.

A ring composed either of iron or copper, moving inside of a solenoid, and actuating the two carbon holders by means of two small chains, suffice to produce a shapely arc and to regulate its operation. The illustration, Fig. 1, shows



FIGS. 1 AND 2.—THE ZWEIFEL ARC LAMP.

the mechanism of the lamp diagrammatically, and Figs. 2 and 3 the working parts and lamp complete in perspective. The ring A consists essentially of one part of iron, cross hatched in Fig. 1, whose section increases from *d* to *e* and which is supported by an arm *b*; the iron portion is completed by the part *c c* of brass, in such a manner that the grouping of the iron, brass, and the arm *b* results in a perfect equilibrium about the axis *a*. To the ring are attached the ends of two small chains *h h'*, on which the carbon holders *p p'* are hung and which are guided within the tubes *t* and *t'*.

The lower carbon holder *p'* is heavier than the upper one *p*, and, therefore, tends to draw apart the holders and to draw the ring to one extremity of its arc of revolution, in which position it is shown.

When the solenoid *s* is traversed by an electric current its tendency is, on the contrary, through the current action upon the iron portion of the ring, to move in the direction of the arrow *l* and to bring together the two carbon holders. The solenoid is wound with fine wire and is placed in shunt to the two carbon holders. It consequently controls the difference of potential between the two carbons, or, in other words, the distance between them. It is important that this distance be maintained to obtain a regular light whose intensity may be adjusted at will by means of a suitable rheostat.

The operation of the lamp will now be readily understood. When no current traverses the lamp the unbalanced weight of the lower carbon holder *p'*, acting upon the little chain *h'*, causes the ring to turn from left to right

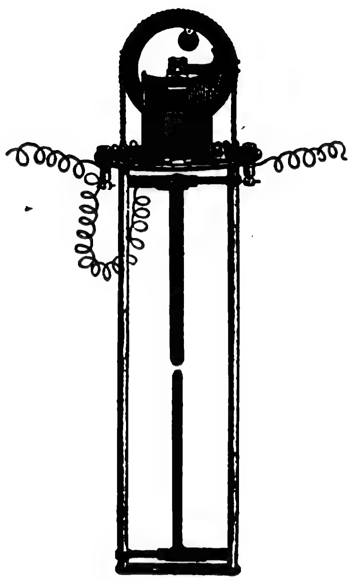


FIG. 3.—THE ZWEIFEL ARC LAMP.

with the result of putting it in the extreme position in which it is shown, and consequently drawing apart the carbons; but if the lamp is connected with a source of electricity the current will have no path across the carbons, but through the bobbin of the solenoid, which will act energetically upon the iron part of the ring, and moves it from right to left. The upper carbon then decends and the lower rises, until the two meet, when the whole current passes through them; the bobbin receiving no current, will have no influence upon the armature, and the overweight of *p'*, acting upon the ring in an opposite direction, the carbons separate and the arc forms.

As the arc lengthens, the current encounters more resistance across the carbons and a portion of it will again pass through the solenoid, which becomes more powerful as the arc lengthens.

THE ROVELLO ELECTROLYTIC PROCESS FOR EXTRACTING COPPER.[1]

THE cupriferous water obtained in the process of roasting copper pyrites in the manufacture of sulphuric acid is usually treated with iron filings, which precipitate the copper in the condition of an impure mass containing about 75 per cent. of copper, which it is necessary afterwards to compress, dry, melt, and refine. The object of M. Rovello's process is to electrolyze this cupriferous water in such a manner as to precipitate the copper in such a form as to render it immediately useful. His apparatus consists essentially of a large Daniell battery, the electro-negative elements of which are of sheet or cast-iron, instead of zinc, and are separated from the copper plates by porous partitions. The electromotive force of an element of this kind (iron-copper) being about .6 volt, a current of 200 amperes should be obtained with a battery of an internal

1. *L'Electricien.*

1. *La Lumière Electrique.*

resistance of .003 ohm, capable of precipitating (at the rate of 1.19 grammes per ampere hour) 6 kilogrammes (13 lbs.) of copper per hour. In order to lower the internal resistance to .003 ohm, it is necessary to use electrodes with large surfaces and diaphragms of very low specific resistance. The electrolytic batteries are built up of a series of wooden frames separating the cathodes from the anodes by membranes of parchment. The anodes and cathodes are respectively fastened together by bars of copper. The frames and parchments are pierced by four holes, in which are inserted four tubes. Two of these tubes communicate with the even elements and a funnel, and the other two with the odd elements and a second funnel. The cupriferous liquid is poured in in a narrow stream and passes through into the cathode compartments, and the solution of sulphate of iron is poured into the anode compartments. These liquids escape separately by the overflow pipes. The weakened solution of sulphate of copper may afterwards be completely exhausted in a second apparatus. The operation is carried on without help from any source of electricity other than the baths themselves, which are short-circuited.

RECENT ADVANCES IN THERMO-ELECTRIC GENERATORS.

Since the discovery of the thermo-electric principle of current generation by Seebeck, many devices and arrangements of metallic couples have been conceived with the object of increasing the effect obtainable; and though thermo-electric batteries have come into practical use to a limited extent for special purposes, the efforts of inventors have rightly been stimulated to test the principle in the construction of apparatus designed to give currents appli-

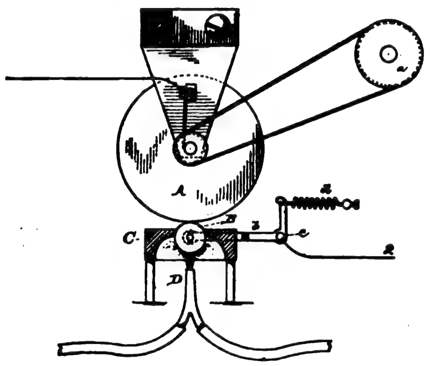


Fig. 1.—Edison's Thermo-Electric Generator.

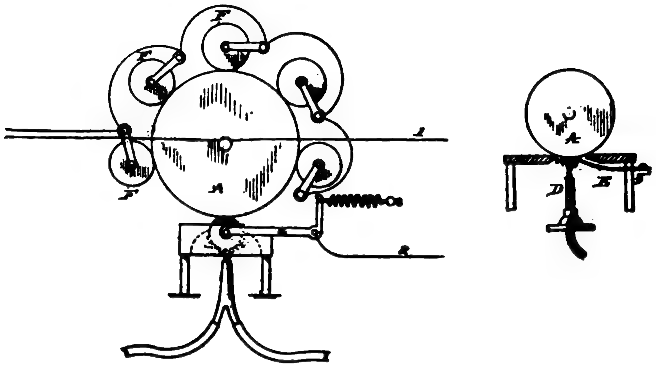
cable to a wider range of work such as electricity is applied to at the present day, and thus to realize to the full the dream of those who seek for the direct generation of electricity from coal.

In order to show the latest efforts in this direction, we desire to bring to the attention of our readers the work of a number of inventors, which embodies some new arrangements of an interesting character.

Among others, Mr. Edison has taken up the subject, and in seeking to increase the E. M. F., maintains the two thermo-electric metals at widely different temperatures at their points of contact. To do this, he rotates one or both of the metals so that they will have a traveling contact, one metal only being heated directly, and the other receiving heat by conduction at the point of contact. The moving of the cooler metal brings constantly new portions of the metal into contact with the heated metal, while other portions of the cooler metal are kept cool by the surrounding air, and thus a widely different temperature of the two metals is maintained, producing a more efficient couple.

This idea has been carried out in various ways by Mr. Edison, one of which is illustrated in the accompanying engraving, Fig. 1. Here A is a disc of iron which is kept in constant rotation. Bearing against one side of the disc A, is a smaller disc B, of copper. The latter is mounted upon an arm *b*, pivoted at the point *c*, and having attached to it a spring *d*, which acts to press the disc B constantly against the disc A. A shield C, of fire-brick, incloses the disc B, except on one side, where it projects through a slot in the shield to press against the disc A.

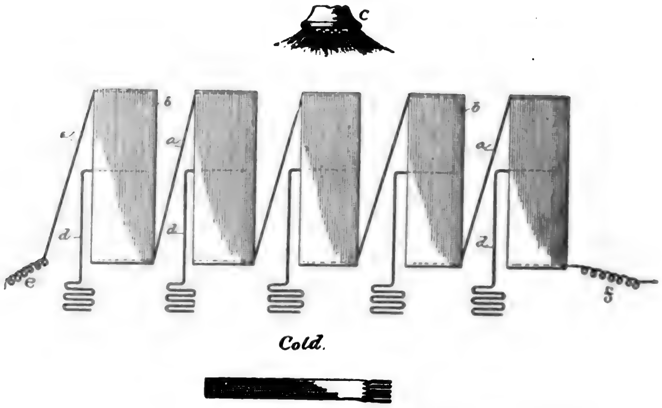
Heat is applied to the disc B within the shield. The lat-



Figs. 2 and 3.—Edison's Thermo-Electric Generator.

ter prevents the direct radiation of the heat from the burner to the disc A, so that the latter is heated only by conduction from the disc B. The disc A being rotated, its contact with B will be changed constantly to new points on the periphery of A, and hence the two metals will be maintained at widely different temperatures at their points of contact, the disc A being cooled by the surrounding air. Circuit-connections are maintained with the disc A by a spring bearing on its shaft, and with the disc B at the pivot of the arm *b*.

Instead of having the heated metal a rotating disc it may be a stationary plate E, as shown in Fig. 3. Again, one or more copper discs F, not directly heated, may bear upon the disc A, as shown in Fig. 2. These serve to assist the



Figs. 4 and 5.—The Cox Thermo-Electric Element.

cooling of the disc A, and produce an electromotive force which is much lower, of course, than that produced between the discs A and B; but it may be utilized through circuit-connections shown.

In seeking to increase the thermo-electric effect, Mr. Harry B. Cox, of New Haven, Conn., has struck out in another direction, and as a result of his experiments finds that the best results are obtained when the length of metal in circuit is as short as possible, and the fall in the "thermic potential" is as great as possible.

With these facts in view, Mr. Cox's object is to produce in a thermo-electric circuit as pronounced a fall in heat potential, and to produce as large a movement of heat within the circuit, as possible. This he accomplishes by the construction of his elements, one form of which is

shown in the accompanying engraving, Fig. 4. As will be seen, each thermo-couple consists of two elements *a*, *b*, composed of unlike metals joined together in the manner shown. The strips *a* extend from one end of one large element *b* to the opposite end of the next adjoining element, and heat is applied at *c*, to the junctions at corresponding ends of the elements. The opposite junctions are kept at as low a temperature as possible. A conducting or radiating strip *d*, of good conducting metal, is connected joined to the conducting or radiating strip *d*. The object of the strips *d* is to produce as great a fall in thermic potential between the junctions as possible.

It will be observed that the conductors or radiators, *d*, are connected between the junctions and extend out into the atmosphere. This prevents them from not only attaining the same temperature as the element, *b*, but in fact reduces the temperature of the element, and tends to very materially lower the temperature between the junctions, and thus produces the object sought for; that is, a pronounced fall in thermic potential.

In applying this form of thermo-element in practice Mr. Cox employs the arrangement illustrated in Fig. 6. The elements, it will be noted, are ranged in the form of a ring. A series of these rings is then piled one above the other and separated by insulating material. The interior surfaces are covered with fire-proof material, and the

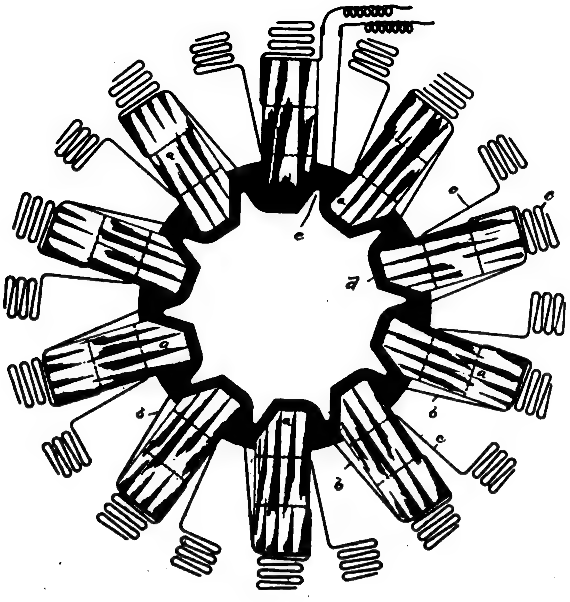


Fig. 6.

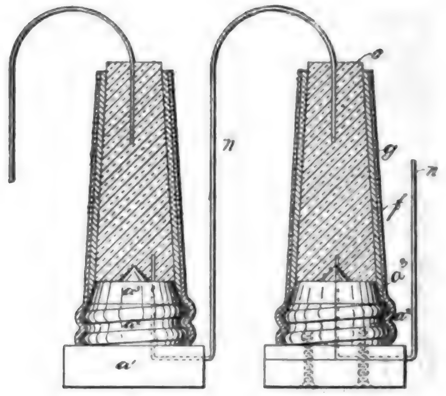
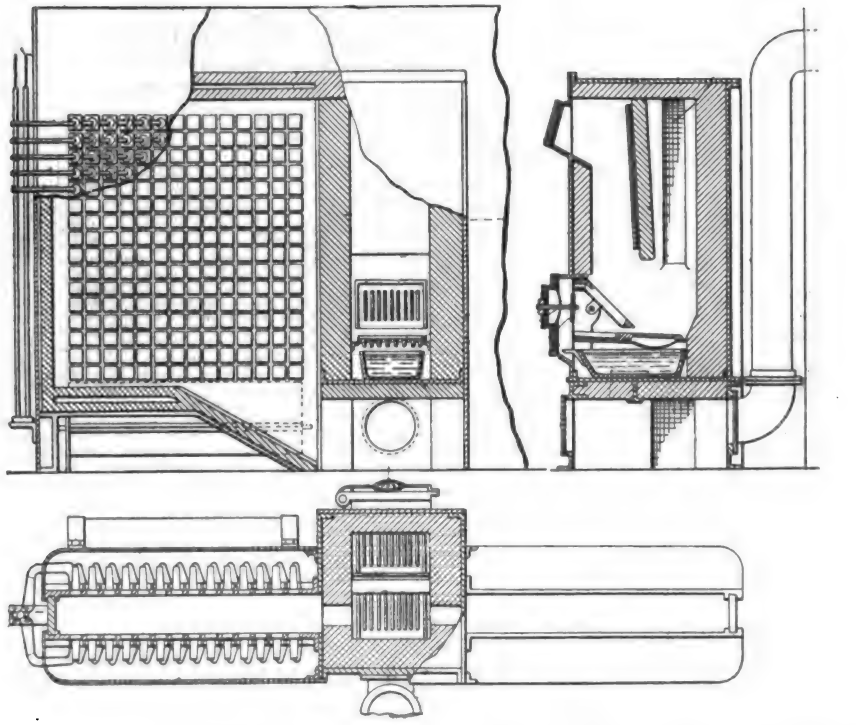


Fig. 8.



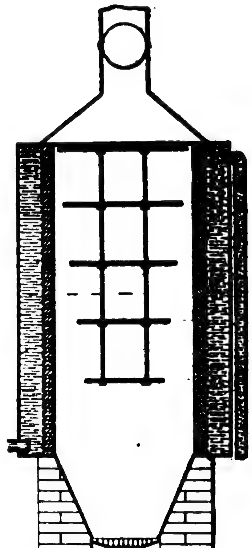


Fig. 7.

Figs. 6, 7, 8, 9, 10 and 11.—Recent Developments in Thermo-Electricity.

with and extends from the elements *b*, between the portions of the same exposed to heat and cold, toward the source of cold.

In connecting and constructing the parts the ends of the metal strips *a* and *d* are slit, as shown in Fig. 5, in such a manner that the metal composing the element *b* can be cast around and make a firm connection with it. The metal composing the element *b* is also cast around and thus whole constitutes a furnace arrangement such as shown in Fig. 7. In order to avoid unequal heating, a series of horizontal deflecting plates are placed on the interior of the furnace, so that the heated gases are evenly distributed to the exposed elements.

Finally, we would call the attention of our readers to a form of thermo-electric generator due to Mr. Hugo Mestern, in which the inventor has arranged his elements so

that one of the metals may be subjected with impunity to intense heat and still leave the other protected, though in close proximity to the former. The arrangement adopted is shown in the illustration, Fig. 8.

The negative electrode consists of a cast iron metal block composed of the square base a', with a screw-shaped part, a^2, above which is a circular end piece, a^3, terminating in a cone-point. In this metal block is placed the conducting-strip, *n*, which is cast in. A hollow asbestos covering sleeve, *f*, is cemented to the part, a^3, of each electrode, and the conical case, *g*, is screwed over a^2 and a^3. Through the screwing of the case the asbestos block has its lower end pressed firmly on the negative electrode, so that between the insulating-sleeve, *f*, and the parts a', a^2 and a^3 a complete junction is effected.

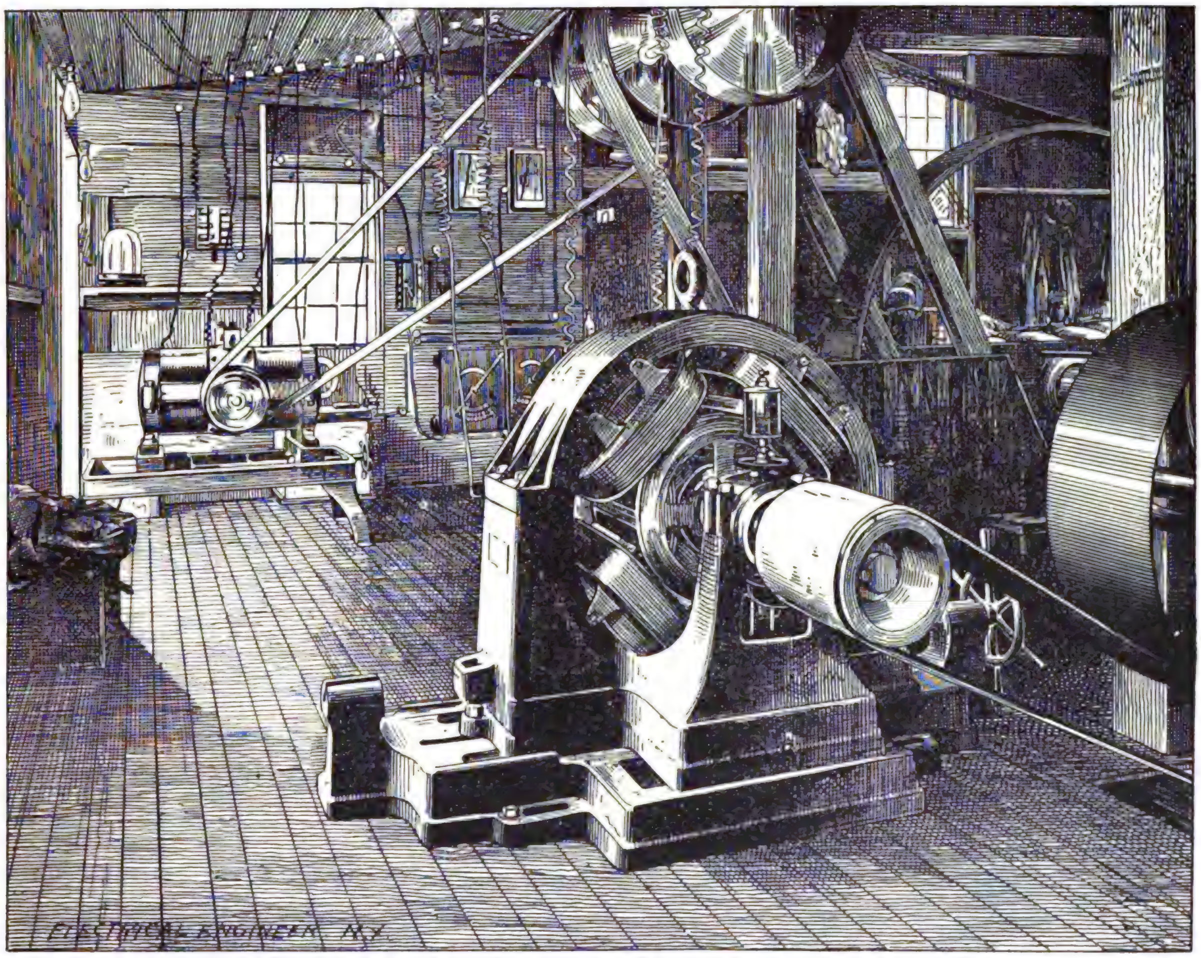
The conducting-strips, *n*, have their upper curved part terminating in the middle of the neighboring positive electrode. The fluid metal of the positive electrode, consisting of some easily-fusible metal, such as antimony, zinc, or an alloy, is then poured into the opening of the asbestos tube, *f*, and the row of elements is ready.

The elements constructed in the manner described are then arranged in a frame, two of which are placed in a furnace, the arrangement of which is shown in the engravings, Figs. 9, 10 and 11. The positive electrodes are kept as cool as possible, and for this purpose the battery is covered with a metal case, in which, through a regulator, cold air is admitted from the outside.

The construction of the elements has been so arranged that should the positive electrode, through the heating of the furnace-battery, be melted at its point of connection with the negative electrode, no escape of the melted metal or alloy can occur, owing to the construction of the asbestos sleeve and the protecting-mantle, so that any break down in the element is thus guarded against.

THE ELECTRIC GENERATING PLANT AT THE WILLOCK COAL MINE.

In our issue of August 20, we gave a detailed description of the underground electrical equipment installed at the First Pool Monongahela Coal Co.'s mines at Willock Station, Pa., by the Mill and Mine Electric Equipment Co., of Pittsburgh, Pa. This consisted of a number of the Hercules coal mining machines and a pump, driven by Tesla alternating motors built by the Westinghouse Company; and to complete the details we give in the accompanying engraving a view of the power installation. This consists of two 12 x 20 Carter engines and one 80 h. p. 3-wire alternating generator. As will be seen, the generator has four poles, and in order to obtain the quarter phase difference in the two branches of the 3-wire system, the armature is wound with two sets of four coils each which overlap each other. The field magnets are excited by a part of the armature current which is commutated, and the speed of the machine is such as to give 6,000 complete reversals per minute.



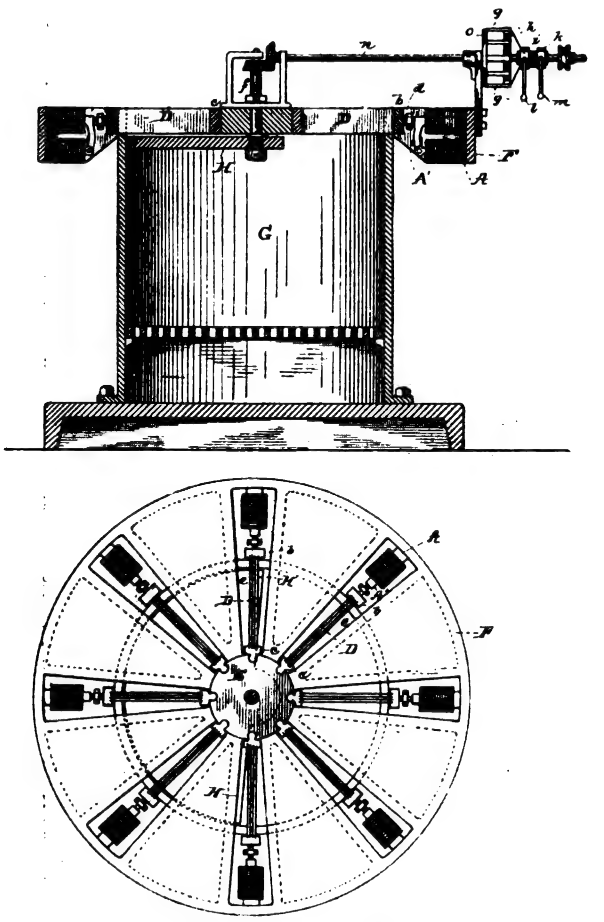
Electric Generating Plant at the Willock Coal Mine.

The Standard Electric Co., of Vermont, have received the contracts for a 300 light plant in the Sullaway Mills, Franklin Falls, N. H., and a 300 light plant for J. B. Van Sciver, Camden, N. J.

EDISON'S NOVEL ELECTRIC GENERATOR.

MANY attempts have been made heretofore to utilize in the operation of prime motors the expansion and contraction of solid matter; but the expansion and contraction between practicable limits is so small that no mechanical means has as yet been obtained which would utilize these small movements for practical purposes. The problem is to transform the exceedingly small movements, which can be obtained by the expansion and contraction of solid matter due to variations in temperature, into energy capable of practical use. Mr. Edison some time ago took up the study of this problem and has succeeded in designing an operative apparatus by applying the movements to the opening and closing of a magnetic circuit. The arrangement is based upon the well-known fact that the resistance of air to magnetic lines of force or stress is about twelve hundred times that of soft iron.

Now, if short stout magnets are divided into two parts, with their faces accurately ground to fit together like two



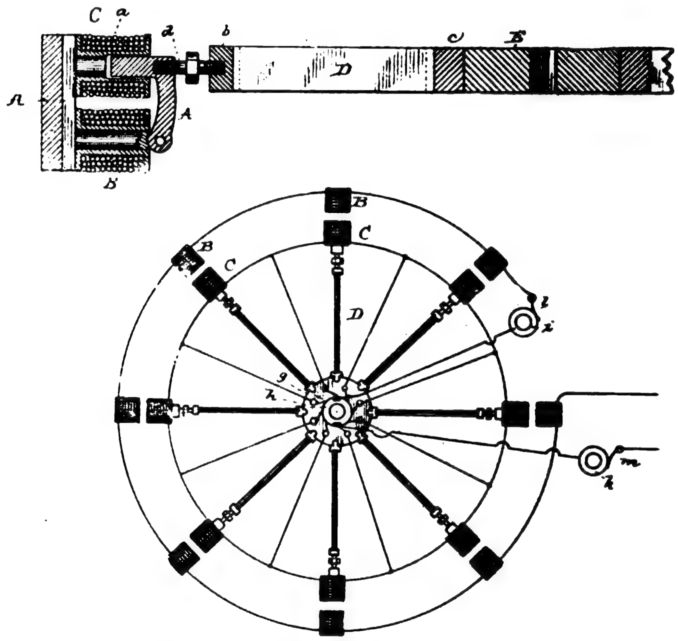
FIGS. 1 AND 2.—EDISON'S NEW ELECTRIC GENERATOR.

surface plates and are magnetized nearly to saturation, an enormous force is required to pull them apart and open the magnetic circuit; but if the faces are separated even to the slightest extent, say one two-hundredth part of an inch, the attraction is reduced enormously on account of the interposition in the magnetic circuit of a layer of air, whose specific resistance to magnetic stress is twelve hundred times greater than the iron. Mr. Edison has found that a large percentage of the force required to entirely open the magnetic circuit must be expended in producing this first slight separation of the surfaces, and hence the energy to be gained by a further separation of the surfaces is of much less importance.

If, now, the magnetic circuit be covered in part by wire through which a current is passed, it can be magnetized and, if it is also covered in part by other wire, particularly in the vicinity of the rupture of the circuit, induction waves will be produced in the latter coils when the magnetic circuit is opened or closed to the slight extent stated. This small movement being within the practical limits of the expansion and contraction of solid matter, Mr. Edison is thus enabled to obtain the full value of the almost irresistible force of expansion in solids for practical purposes.

The manner in which this has been carried out in practice is shown in the accompanying engravings, Figs. 1 and 2, which show the apparatus in section and in plan view, respectively. Fig. 3 shows one of the elements of the generator enlarged.

Each element of the generator is a magnetic circuit A, one portion A′ of which is pivoted upon the part A, the movements of the latter producing the opening and closing of the magnetic circuit at the point *a*, the surfaces being fitted accurately together. One side of the magnetic circuit is covered with energizing-coils B, while the other side, covering the point *a*, at which the magnetic circuit is opened and closed, is provided with the coils C in which current is induced. Thus it will be seen that the magnetic circuit is opened and closed directly within the coils C. The touching of the surfaces at *a* causes the lines of magnetic force to travel almost entirely through the iron forming the magnetic circuit, while the separation of these sur-



FIGS. 3 AND 4.—EDISON'S NEW ELECTRIC GENERATOR.

faces even to the slightest extent causes the lines of magnetic force to strike out through the surrounding coils C, and thus induce current in those coils. These lines of force are again withdrawn by the closing of the magnetic circuit, and thus a current of one direction is induced in the coils C when the magnetic circuit is opened, and a current of the other direction when the magnetic circuit is closed.

To move the pivoted part or keeper A′ of the magnetic circuit, there are attached to A′ a number of sheets D of nickel, which are secured to end pieces *b* *c*. Entering the end piece *b* and the keeper A′, and connecting them together, is a bolt *d*, by which the parts can be given the proper relative adjustment. The end piece *c* is set into the central hub E. A number of these elements are mounted in openings *e* in the top plate of the furnace, the top plate extending beyond the sides of the furnace, so as to keep the magnets away from the heat of the furnace and to permit them to be kept cool by the direct circulation of air around them.

The products of combustion from the furnace pass up through the openings in the nickel sheets D, and thus heat

them. When they are cold, or not subjected to the direct action of the heat, the magnetic circuits are opened, the sheets being maintained under stress by the magnetic attraction which tends to close the magnetic circuits.

A revolving shield, or director of the heat, H is mounted upon a shaft *f*, and carries the shield on its lower end within the furnace. This shield covers one-half of the openings *e* in the top plate, and, being revolved slowly, successively closes the openings on its advancing side and opens those on its retreating side. Thus one-half of the nickel sheets will be cooling while one-half will be heating, those that are cooling producing a current in one direction while those that are heating are producing a current in the other direction in the coils C.

For producing a continuous current, the coils, C, are connected together in a closed circuit, as shown in the diagram of the circuit connections, Fig. 4, while between the coils connections are made to commutator-springs, *g*, resting on a disc, *h*. This disc is of insulating material except at two opposite points in its periphery, where it is provided with plates of metal. These plates are connected with two rings, *i k*, upon which rest springs, *l m*. The springs, *g*, being stationary, and the disc, *h*, being rotated, the main circuit will be connected with the coils, C, through those springs, *g*, which rest upon the metal blocks in the disc, *h*, and thus the circuit-connections will be advanced with the movements of the shield, H, and a continuous current will be produced at the springs, *l m*. To take the commutator away from the influence of the heat, there is provided a horizontal shaft, *n*, which is connected by beveled gear with the vertical shaft, *f*, and has the same speed. A plate, *o*, carrying the stationary springs, *g*, is mounted upon the outer bearing of this shaft.

For energizing the coils, B, a separate source of energy may be used, or the coils may be supplied directly from the apparatus itself, as shown in Fig. 4, a galvanic battery being used to energize the coils in starting and being afterward removed from the circuit when the machine is started. It is evident that permanent magnets may be used in place of the electro-magnets, and that many forms of the expansible body can be utilized, but Mr. Edison prefers a divided body or one having thin walls, so that it can be quickly heated and cooled.

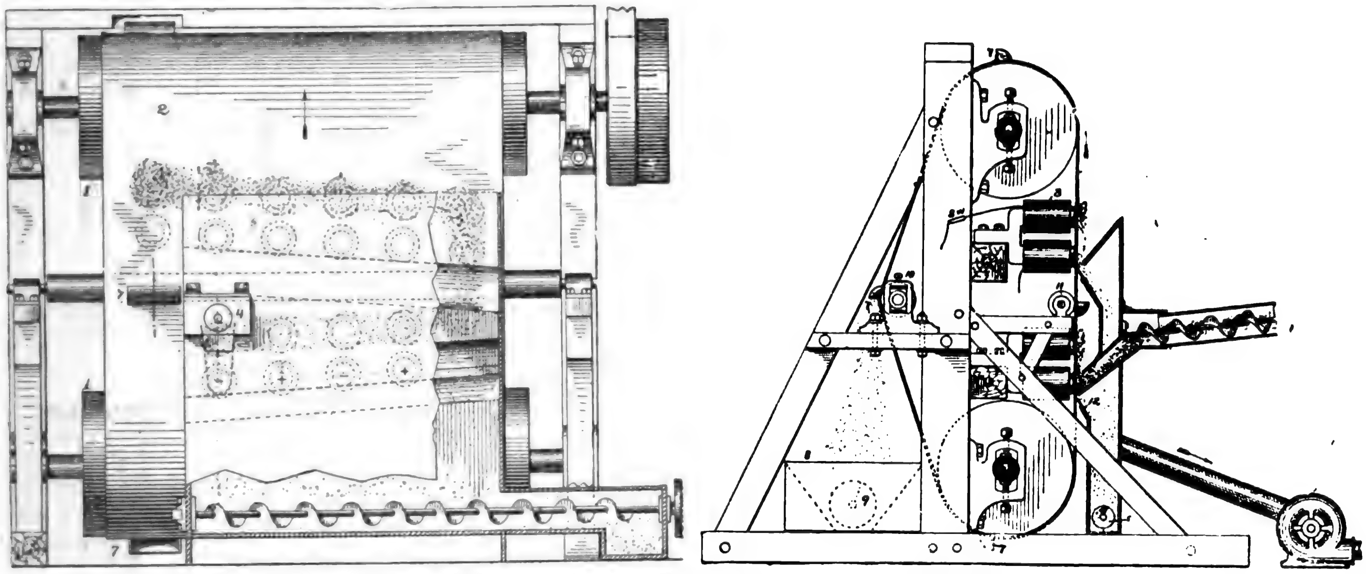
Instead of using solids for the expansible body, Mr. Edison has also employed liquids, the expansion being produced by hot water or steam passed through copper pipes coiled in a chamber or cylinder in which the liquid is placed. The expansion and contraction of the liquid produce movements of a piston which is connected by its piston-rod with the keepers of the magnets.

THE EDISON-DICKSON MAGNETIC IRON ORE SEPARATOR.

THE separation of the magnetic particles from the gangue in magnetic iron ore presents no great difficulties when the iron particles to be separated are in the shape of grains or in larger masses; but when the iron is present in the form of exceedingly fine particles, surrounded by a large proportion of gangue, the usual methods are inadequate to separate the iron, and special means have to be adopted.

To meet such cases, Mr. Edison, in connection with Mr. Wm. K. L. Dickson, has designed the ore-separator which is illustrated in two views in the accompanying engravings.

The ore, finely pulverized and either wet or dry, is fed in a continuous stream by the conveyer to the magnetic field adjacent to the lower pole of the first of the series of magnets shown, which are arranged with opposite poles adjacent. The iron particles are strongly attracted by the pole and tend to remain in the magnetic field. The heavy and loose non-magnetic material falls by gravity on the plate 12, and thence into the receptacle provided therefor. The continuous movement of the belt 2 tends to carry the iron particles away from the lower pole to the upper pole, and when the field of the first mentioned pole becomes overloaded the iron particles gradually work over to the upper pole, and in a short time the field adjacent to the upper pole also becomes loaded. The moving belt tends in the same way to raise the material away from this upper pole. At the same time the attraction of the magnet and the attraction of gravity force it back into the field.



FIGS. 1 AND 2.—EDISON-DICKSON MAGNETIC ORE SEPARATOR.

In this way the iron particles associated with and adhering to the gangue are beaten about and turned over and over and rubbed together in the magnetic field. This action allows the free foreign matter to drop, and at the same time loosens material which may adhere with considerable force to the iron particles. In a short time, in the operation of the machine, the field of the first magnet becomes loaded, and the magnetic material is slowly drawn by the adjacent pole of the next magnet to itself, thereby partially unloading the first magnet. The materials receive over this second magnet the same shaking and agitation as described in connection with the first magnet, and when the second magnet becomes overloaded it yields its load to the third magnet, where the operation is repeated, and so on through the series. The iron by the time it reaches the last magnet is practically free from the gangue, and is taken by means of the pockets shown, into receptacles provided for the purpose.

In the actual operation of the machine very little iron

gathers over the lower pole of the magnets, owing largely to the fact that the moving belt or cylinder tends to carry the material to the upper pole and away from the lower pole.

SCOTT'S FLASH SIGNALING LANTERN.

This lantern is the invention of Commander Percy Scott, R. N., and has been designed with a view to enable signals to be sent on the Morse system with greater rapidity than has heretofore been possible, and from a point where the present mechanical arrangement of shutter could not well be employed.

The lamp is surrounded by a number of vertical shutters pivoted above and below, and engaging by means of short arms or toothed wheels with a central wheel. The motion of the latter is produced by an electro-magnet acting against the force of springs; when the magnet is energized a rapid but short movement of the wheel takes place, opening the shutters for a longer or shorter period, as desired, and produces thereby longer or shorter flashes of light. The action of the springs carries the wheel back to its original position as soon as the current is broken in the electro-magnet. The electrical circuits are arranged in a special manner with the view of avoiding running the lamp at full incandescence during such time as the shutters are closed, and consequently the light is obscured. The magnet coils are, therefore, put in circuit with the lamp, the resistance of the former acting so as to dull the incandescence, but only to such a point as will allow the thick filament necessary for the 100 c. p. lamp employed to be raised to its full incandescence during the period of the shortest flash which may be found possible to use in practical working.

In order to further reduce the strain put upon the lamp by the heat developed during continuous running, a special switch is employed in connection with this lantern. The handle of the switch is hinged in such a way that under

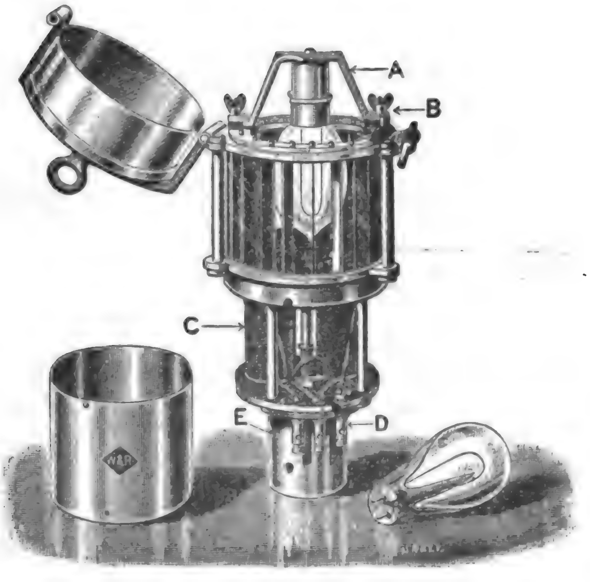


Fig. 1.—Scott Signaling Lantern.

normal conditions a strong string is pulled upon the end of it and breaks the main circuit to the lantern.

In order to commence signaling it is necessary to pull down the handle against the force of the spring; this completes the circuit to the lantern, and a further depression operates the telegraph key controlling the shutters. The contacts are so arranged that in the act of opening the shutters the lamp and magnet circuits are momentarily in shunt to one another, and as the E. M. F. absorbed by the magnet coils is only eight volts, the amount of sparking during signaling is very small. Extra contacts are attached to the switch to enable a Morse instrument to be added whereby the signals may be automatically recorded in the same way as in telegraphy. The action of the lantern is very satisfactory, and one of the original type has been in work for several months on board H. M. S. "Northumberland."

Our two illustrations show both the lantern with its shutters open, as is the case when no current is flowing, and also with its cover and tube removed to show the inner details. At A is shown the form of holder adopted, which, by unscrewing the fly nuts, B, enables the lamp to be at once removed for the substitution of a new one; at C are the two magnet coils, actuating the armature; and at D are three terminals respectively joined to the magnet

Fig. 2.—Scott Signaling Lantern.

coils, the lamp and one dynamo terminal. The framework supporting the shutters is complete in itself, so as to be removable in the case of any repairs being necessary to this very important part of the mechanism. E is a stout tube enabling the lantern to be fixed on the top of a mast, to which it is pinned through the hole seen in the side. It may equally well be suspended from the ring attached to the cover.

It is hoped that by means of this lantern it may be possible to attain to such speed in flash signaling that the two parties may be able to interpret each other's signals, which at present, owing to the different rates at which the signals are sent, is found to be very difficult.

The work in connection with this lantern has been entrusted to Woodhouse & Rawson, United, Limited, of London, the well known electrical engineers. This lantern can, of course, be used for signaling by the merchant marine, and on any ship fitted with the electric light.

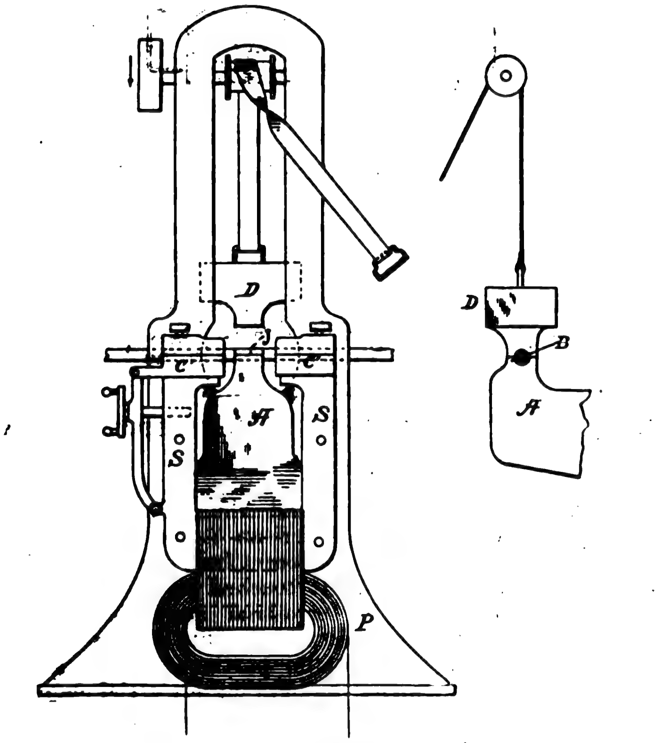
IN FAVOR OF ELECTRIC ROADS.

The *Boston Advertiser* presents interesting and important information as to the working of electricity in connection with street cars in several cities of the Union. The testimony thus obtained is almost invariably in its favor. The result is encouraging, of course, to the public of Boston, in which the system is established, and is likely to remain. There are special difficulties attending it here, from the fact that a portion of our streets in which it is used are narrower and more crossed than in most of the other places, yet in the severe test which overhead electric wires are undergoing this week there has been a gratifying success, as far as safety is concerned, and we have strong hopes that it may be continued. The *Advertiser's* survey comprehends cities in all quarters, and the uniformity of the intelligence that comes from them is remarkable.—*Boston Herald.*

ELECTRIC WELDING IN CONNECTION WITH THE DROP PRESS.

It is but a few weeks since that we drew attention to a variety of interesting developments in the application of electric welding to the working of metals, and now are again able to note a further application devised by Prof. Thomson. In this latest work Prof. Thomson has, as it were, combined his electric welding apparatus with a drop press in the ingenious manner illustrated in the accompanying engravings, Figs. 1 and 2, which are so clear as to need no further description.

The operation of the combination is exceedingly simple. When the pieces are to be welded under the drop, the drop D, is raised and sustained in an elevated position. The bars, B B′, are put into the clamps, slightly clearing the lower anvil, A, and abutted fairly well. The current is put on while the pieces are being pressed together at the joint, J, and gradually the joint attains a welding heat, as well as a section of the bars on each side of the joint. At this moment the drop is allowed to fall and completes the work,



Figs. 1 and 2.—Thomson's Combined Electric Welder and Drop Press.

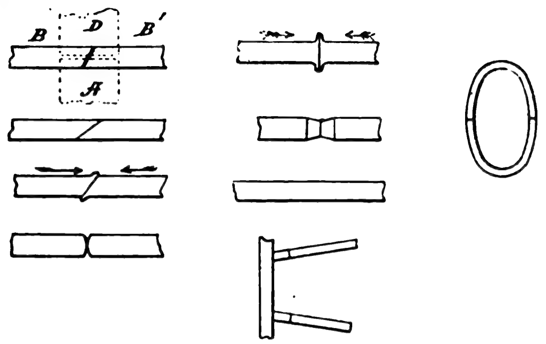
after which the welded piece is removed for the insertion of others.

One of the ways of preparing the ends of the pieces is shown in Fig. 3, the two ends being slightly scarfed or tapered before welding between the drop and the anvil. It is found that this preparation, which is shown in a still more exaggerated form in Fig. 4, produces a partial lap and a partial butt-weld of very great strength and uniformity.

Fig. 5 shows how the pieces are pressed together when they become plastic and before the descent of the drop. They tend to ride up a little one upon the other on account of the slanting surfaces. As soon as the welding heat is reached the descent of the drop welds and completes the joint.

For butt-welding the pieces are prepared with a rounded surface, as in Fig. 6, placed in contact and afterward pushed up to form a burr or expansion, Fig. 7, before dropping. It is advisable, however, in welding not to form too great an expansion of this kind, and it is also desirable that the clamps, C C′, one or the other, be movable toward the other when the drop comes down, so that the metal may spread endwise during the formation or shaping of the bar. This latter precaution may be entirely obviated by striking the pieces when they have attained, from the shapes shown in Fig. 6, a partial butt-weld, indicated in Fig. 8, a slight depression existing around the joint or metal section, which, when the drop descends, is completely filled up with the hot and plastic metal at the welding temperature, so as to give a finished and smooth surface, as in Fig. 9.

By making the surface of the drop and anvil more com-



Figs. 3 to 11.—Samples of Electric Welding and Drop Forgings.

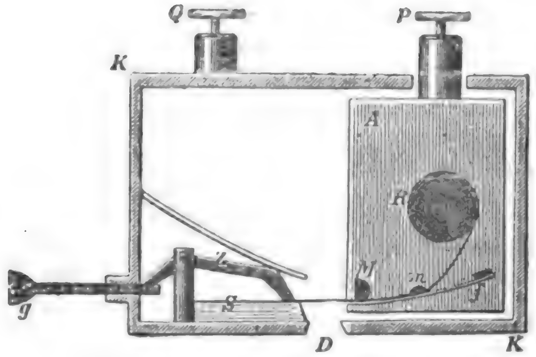
plicated in outline, almost any form of work may be accomplished. Thus two joints, Fig. 10, may be made and finished in one operation, and in making a chain-link of two of the pieces, Fig. 11, both joints may be struck at one operation into the desired form.

Although designed more particularly to effect the electric welding of separate pieces, it is also well adapted to the making of drop-forgings.

THE SIEMENS-VIOLLE STANDARD LAMP.[1]

BY DR. E. LIEBENTHAL.

The forms up to the present suggested for obtaining the unit of light passed by the Paris Congress have all of them many inconveniences, being both difficult to manage and most of them costly. That illustrated in the accompanying figure has been specially designed to overcome these difficulties. A stand some 4 in. high carries a box, K K, shown full size in the figure. On the bottom of the box is



The Siemens-Violle Standard Lamp.

an insulated metal plate, A, on which is a small drum of platinum strip, R, a movable half cylinder, *m*, a larger fixed one, M, and a terminal, P. The strip passes under M and *m*, against which it is pressed by the spring, *f*, and thence to the plate, S, where it is clamped by the claw, Z. The strip is now stretched by turning *m* backwards, and on passing a current through the instrument the platinum strip is melted, the light being observed through the aperture, D. The handle, *g*, is now pressed, pushing S and Z forward, and at the same time lifting Z. On pulling *g* back, Z falls again, clipping the end of the platinum, and drawing on a fresh piece for the next reading.

1. *Elektrotechnische Zeitschrift.*

The lamp does not absolutely fulfill the requirements of the Congress, as the source of light is platinum just melted, instead of melted platinum on the point of solidification; but, if it should be found necessary, a correction factor may be ascertained once for all. The cost is infinitesimal compared to that of the original standard, one gramme of platinum, costing about 65 cents, being sufficient for 50 readings. The metal is also obtained pure without difficulty, as there is, of course, no fouling due to the source of heat.

Preliminary trials with the lamp showed several small defects in the means of making contact on the right-hand side; these, however, were overcome by covering M with platinum, and abolishing *m* altogether, the strip being tightened by manipulating *g*. It was found also that more or less tension had but very slight effect on the results obtained. The current used varied from nine amperes to as much as double, due to variation in the gauge of platinum supplied. The strip used was about 5.5 mm. broad and .011 mm. (.44 mils.) thick. A very large number of comparisons were made against the amylacetate standard, the current being slowly augmented, and the grease-pot carrier slid along the photometer bar as the light increased, the point at which the carrier stood when the coil fused being taken as the reading. The results obtained do not agree perfectly among themselves, the mean error in 180 readings being 2.9 per cent., whereas the same observer made two amylacetate lamps agree within 0.95 per cent. The errors are attributed both to variation of the platinum standard itself, and also to the fact that just before

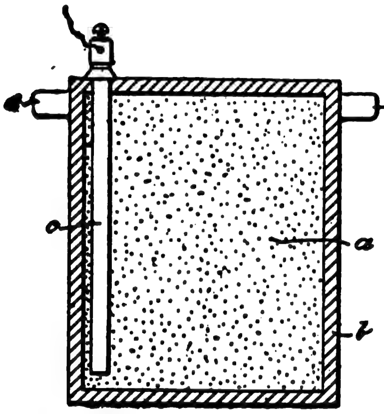


FIG. 1.—HOLLINGSHEAD'S SECONDARY BATTERY PLATE.

melting the light is considerably whiter than the amyl standard.

As the final result Dr. Liebenthal gives the value of the amylacetate standard as .569 Congress unit.

Herr v. Siemens originally gave the figure as 0.7 legal unit, but thought that this was probably too high, owing to impurities in the platinum.

From previous experiments the value of the English standard candle had been found to be 1.169 that of the amylacetate lamp, which makes the legal value of the candle .665 legal unit. On the other hand, M. Violle himself has made the value .54, a difference of over 20 per cent.

In conclusion Dr. Liebenthal says that owing to the color the platinum lamp is best suited for arc-light determinations, and recommends that the platinum should only be about .2 to .3 mils thick.

HOLLINGSHEAD'S SECONDARY BATTERY PLATE.

THE reduction in the weight of storage batteries has, for obvious reasons, been one of the chief aims of those engaged in their construction, and various methods have been employed to attain that end. Among others, we may note the construction in which all vestige of the usual grid has been removed, the active plate consisting merely of a compressed mass of lead oxide. This form, however, has been open to the objection that crumbling takes place in time as the battery is worked; and, hence, to avoid this, and still obviate the necessity of using a metal grid, Mr. W. B. Hollingshead, of Bronxville, N. Y., has designed the type of plate shown in the accompanying engravings. This plate, as shown in Figs. 1 and 2, consists of the active material, *a*, such as red lead or black oxide of manganese, inclosed in a crust, *b*, of porous material and having a car-

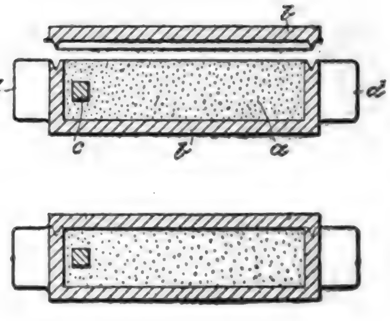


FIG. 2.—HOLLINGSHEAD'S SECONDARY BATTERY PLATE.

bon or other conductor, *c*, connecting with it through the crust.

Mr. Hollingshead makes the crust of plastic kaolin in two parts, and then incloses the material and joins the edges of the parts in the manner shown in Figs. 2 and 3, after which he bakes the crust and produces the porous condition. The crust is provided with lugs, *d*, projecting from the sides, for suspending the plate in the jar.

ELECTRICITY AT THE AMERICAN ASSOCIATION.

BY PROF. H. S. CARHART.

THE address of Prof. Cleveland Abbe, vice-president of the Physics section of the American Association for the Advancement of Science, at the recent Indianapolis meeting, was on Terrestrial Physics. It touched upon the obscure question of the origin of terrestrial magnetism. Prof. Abbe concludes from the low permeability of iron at high temperatures that the metallic portions of the earth's interior cannot be magnetized, and that terrestrial magnetization must be restricted to the earth's shell or crust. He therefore inclines to the theory of magnetism derived from terrestrial currents in planes at right angles to the axis of rotation. He reasons that the earth is immersed in a dielectric, and is placed in some kind of electrical field due to solar radiation. If this were the case it would require no inconsiderable currents round the globe as a solenoid to produce the known terrestrial magnetism, since the cause operating to prevent permanent magnetism in the earth's interior would also prevent such material from serving as the core of an electro-magnet.

In the physical section Prof. Mendenhall presented facts, derived from the magnetic observations of the Coast and Geodetic Survey, going to show that magnetographs often record earthquake disturbances, not as mechanical shocks, but as magnetic perturbations. These he conceives to be due to the sudden stresses to which the earth is subjected in earthquakes; and these stresses modify the earth's magnetism. In support of this view he showed, from an analysis of the photographic records of magnetographs, that two diurnal fluctuations in declination depend upon lunar action; and he ascribes these to the stresses in the earth's crust produced by the same forces which raise the tides. The subject will be pursued further by observers of the Geodetic Survey.

Prof. Nipher, of St. Louis, described a new method of

measuring the electrical resistance of liquids, such as the internal resistance of a battery. It consists briefly in placing the resistance to be measured in one arm of a bridge with a two-part commutator to effect rapid reversals of the current through the electrolyte. From measurements thus far made the results are found to agree with those of approved methods to within one per cent.

Mr. E. G. Merritt described the peculiar behavior of a galvanometer when used with a thermopile. It consists in small periodic pauses in the deflection of the needle when the thermopile is exposed to a steady source of heat radiation.

These pauses, which may even amount to reversals in the motion of the needle, for a short distance, are always equidistant in time; and the first maximum bears a definite ratio to the total deflection which the needle will reach if the radiation upon the face of the pile be continued indefinitely. Comparisons of different sources of radiant heat may, therefore, be made by observations of the first maxima occurring at the first pauses of the needle. The phenomenon was shown to be due to the composition of a damped vibration of the needle, and a deflection produced by an E. M. F., the law of variation of which may be expressed by an exponential curve. The paper was an admirable example of a short investigation completely worked out.

Sections A, B, C, and D of the Association spent one day by invitation at Terre Haute and held sessions in the Rose Polytechnic Institute. An elegant dinner was served at the Terre Haute House to the 200 guests, and Col. R. W. Thompson, ex-secretary of the Navy, made the address of welcome. Col. Thompson welcomed the Association to the same place nineteen years ago. He excited lively interest by his vivid narrative of experience with Morse and of his efforts to secure a $25,000 appropriation from Congress to construct an experimental telegraph line. In this connection he said that one of his colleagues was subsequently defeated for Congress because his constituents disapproved of his vote for the appropriation for the telegraph. What a commentary on the righteous judgment of the people!

Many members took occasion during the meeting to ride on the electric railway in Indianapolis. It works admirably; and the central line of iron poles, carrying the wires, is an ornament to the street rather than a disfigurement. A large party accepted the kind invitation of the Parry Manufacturing Co. to visit their factory for the purpose of witnessing electric welding on a commercial scale. They saw a single workman welding wagon tires at the rate of about three per minute. Two men were engaged in welding inch axles also, and both operations were conducted with the most gratifying success. The process is very satisfactory to the manufacturers, and its rapid introduction into large plants is assured.

The papers presented to the physics sections of the Association included a relatively smaller number on electrical topics this year than for several meetings. Other departments of physics received a larger share of attention than usual. The papers were of a high average, but none reached the highest water mark.

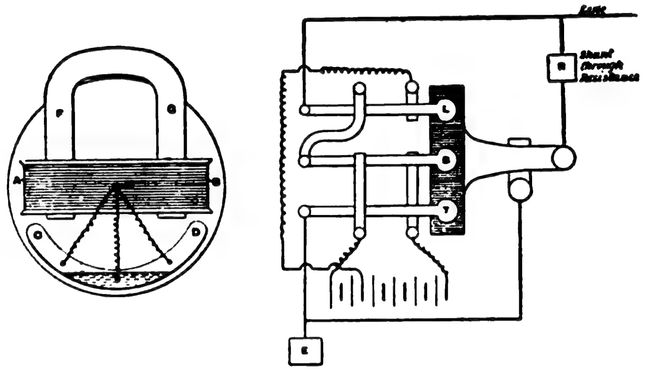
LOCAL INTERESTS IMPROVED BY ELECTRICITY.

Electricity is doing more for the country towns, says the *Pittsburgh Dispatch*, than all other agencies combined. It is lighting villages that would otherwise be groping in the dark, for gas corporations do not settle in such places. The game is not big enough. But the greatest thing electricity is doing for the small towns is the running of the street cars. This has given them a forward impetus that has been of immense benefit to all of their business interests. A great deal of the vim and push seen in Western Pennsylvania towns is due to electricity.

THE new state of Washington is a pretty lively place. There is no lack of enterprise within it. The towns of the state are rapidly adopting electricity for lighting and motive power purposes. The electric lighting company of New Whatcom has decided upon the Westinghouse alternate current system and will immediately install a 750 light plant.

THE BAROTHERMOTELEMETER.[1]

THIS instrument, the invention of Mr. Johnston Stephen and the Lord Justice Clerk, is designed for the purpose of enabling observers to take readings as often as desired, and by a single wire, from barometers and thermometers placed at great heights or distances, without the necessity of the observer being resident where the instruments are placed, thereby saving much expense, and enabling observations to be taken at points where residence might be impossible. The barometer has inserted in its mercury a rod of insulating material, on which a screw thread has been cut, and on this thread a fine wire is wound. An electric circuit established through this coiled wire to the mercury, and by a conductor from the mercury to earth, will, of course, meet with more or less resistance, according to the height of the barometer, as the coils are more or less short-circuited by the mercury. The thermometer has two carbon threads passed down into the mercury, and in the same way as in the case of the barometer, the resistance is increased or reduced by the fall or rise of the mercury lengthening or



FIGS. 1 AND 2.—THE BAROTHERMOTELEMETER.

shortening the circuit through the carbon threads. The procedure by the observer at a receiving station consists in taking, first, a reading of the line resistance, without passing the current through the instruments, then passing the current through the instruments in succession, and taking readings, correcting these by the reading of the line wire.

The mode in which these changes are accomplished is shown in Fig. 1. The flat coil A B is balanced on the pivot E, and the permanent fixed magnet F G rests within the coil. On the circular disc to which A B is attached, a curved tube C D is placed, which has a metal plate along its lower side, and a small quantity of mercury (shown by the shading). Three wires are inserted in the upper side of the tube, one in the centre, and one near each end. When the tube C D is at rest a weak current passed from the line through the centre wire will not disturb the position of C D. The line resistance can thus be noted. If a strong + current be then passed, C D is moved so that the mercury leaves the centre wire and makes contact with one of the side wires, and thus shunts the circuit from the line through the barometer circuit, the resistance of which is then checked. The thermometer is then checked by passing a strong — current, which turns C D in the opposite direction, and makes the circuit through the other side wire. The mode in which these switchings are accomplished at the observing station is shown in Fig. 2. It will be seen that when the key L is used a weak current passes to line; when the key B is used a strong + current passes, and when the key T is used a strong — current passes. In each case when the key is still further depressed it gives the current an alternative path through a bridge and proportional coils, thus enabling the readings of the resistance to be taken. The upper side of the large key which connects the rheostat is covered with insulating material to prevent short-circuiting.

1. *Industries.*

ELECTRICITY AS APPLIED TO THE EXTINGUISHING OF FIRES.[1]

BY H. L. LUFKIN.

To speak of electricity as even a possible agent in the extinguishing of fires would seem absurd if we look for our information only in the daily press, which would lead one to believe that the mode or form of motion known as electricity was potent only as an incendiary to instigate conflagration and death. You will readily concede that of all the elements in nature none possesses so wide a range of applicability as electricity. Since its first commercial use by Cook and Wheatstone in their railway telegraph in 1836 and 1838, followed by Morse in 1844, its development has been simply wonderful, especially in the past fifteen years. In the telegraph it is made to convey intelligible characters; in the telephone, articulate sounds; with it metals may be welded, light produced, power distributed, metals deposited by electrolysis, surgical operations performed by electro-cautery; nervous systems are toned up by galvanism and faradism; our street cars are operated by it, and our steam roads will soon follow; it pumps the organ in our churches, it runs the sewing machine in household and factory, it mines our coal and hauls it out, and why, I may ask, should it not be applied to the extinguishing of fires? Surely it is to-day an important factor in that direction, for does it not with wonderful intelligence advise you not only of the first manifestation of a fire, but of its exact location by means of the automatic fire alarm? Let us go a step further and cause it also to turn the water on and thus extinguish the fire.

Retrospection in this application of electricity shows us an almost undeveloped field. There has been some work done in the line of electric motors applied to pumps for domestic water supply where the city pressure is insufficient for all domestic requirements; also in the application of electric motors and pumps for supplying water under pressure for hydraulic elevators. As applied to fire department uses, there have been devised a number of electric motors and pumps, or electric pumping engines on trucks, which may be hauled about as the present fire engines are. This involves the necessity of a convenient place for connection with the electric light or power wires of a city at, or near, each fire hydrant, and also involves the maintenance of an expensive complement of horses, as in the present system. The pumping capacity, also, of any portable engine is of necessity limited to a weight and construction which can be readily hauled by a pair of horses with reasonable speed over the varying grades of a city. This at times is a serious matter in cities where heavy grades are frequent, especially in the winter time when streets are obstructed by snow, ice, etc. Prompt response to an alarm is, of course, a necessity, and involves the driving through crowded streets at a speed which is, certainly to the uninitiated, frightful, though singularly free from accident.

In lieu of these portable pumping engines and their several more or less objectionable features, I would submit for your consideration a system of stationary pumping engines, the operation of which I trust I may be able to make clear to you with the aid of these diagrams:

Let me first call your attention to the diagram, Fig. 1, illustrating a stationary system of water distribution for fire purposes under electrical control.

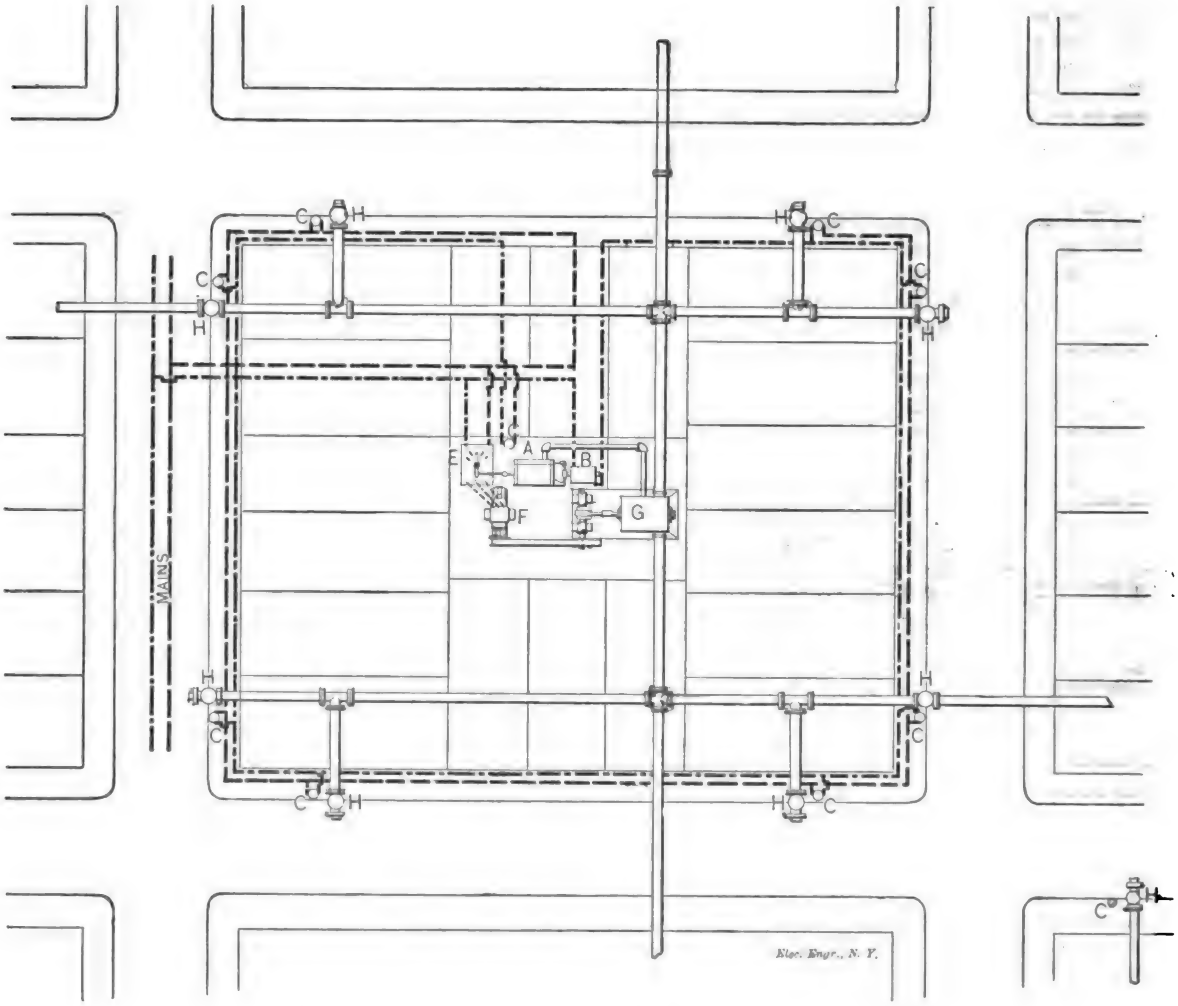


FIG. 1.—LUFKIN'S METHOD OF ELECTRIC FIRE EXTINGUISHING.

In this diagram A represents a hydraulic piston, the valves of which are controlled by the electro-magnet, B, the circuit through the magnet, and, therefore, the piston valves, being controlled by the switches, C C C, etc.

E represents a starting box or rheostat in circuit with the electric motor, F, which is connected by belt or gear to the pump, G. Radiating from the pump, G, is a system of piping connecting to hydrants or plugs, H H H, etc.

The diagram here shown is supposed to represent a city block or square. The pumping apparatus is represented in the centre of the block, though it is obvious that it may be placed in any convenient location which may be available and where it will be out of reach of frost, the system of piping being provided with a draw-off valve near the pump so that the system may be completely drained, if necessary, after use.

The operation of this system is as follows: The hose carriage,

1. A paper read before the Firemen's Convention, Detroit, Mich., Aug. 20, 1889.

with its complement of men, drives up to any of the fire plugs; the hose being attached, the switch, C, is turned. This operates through the magnet, B, and the piston, A, to throw over the switch on the starting box, and thus immediately throws the motor and pump into action. Each district would, of course, be provided with its motorneer, who would attend all fires in his district and care for the motor, pump, etc., during the fire, and whose duty it should also be to daily inspect the apparatus in his district to see that it is kept in proper repair. The motors would in these cases be connected to the mains of some company supplying electricity for light or power, whose charge for this service should certainly be merely nominal.

The water could be drawn from a city supply or from an independent supply provided for fire purposes only. The capacity of these stationary plants also may be equal to the capacity of ten or fifteen engines, if necessary, and the motor so connected to the pump that the pressure would remain the same on the system, whether only one stream or the full capacity of the plant were called for. These stations could also be made to cover a considerable territory, if desirable, and the several districts included in a general system could be connected together with suitable valves between them so that they could be operated separately, or together, as the exigencies of the fire might demand.

A plant of this character, with a capacity of 200 h., p., which would be capable of delivering about 2,500 to 3,000 gallons of water per minute, or, say, 165,000 gallons per hour, against 150 pounds pressure, could be set up and piped to cover quite a number of city blocks, say 10 or 15, at an expense of $20,000. The cost to operate this plant at its full capacity would not exceed $10 per hour, or, at the rate of 16,500 gallons of water for every $1 of cost. When the fire is out the cost stops absolutely. The wear and tear expense on a large plant of this kind should not be as great as on a single steam fire engine, to say nothing of the cost of maintaining horses and harness.

With this reference to a possible application of electricity to a pumping system for fire department uses, let us see what can be done in the way of protecting isolated buildings. The automatic sprinkler has become a familiar sight in many of our large stores and warehouses, and the reduction in insurance rates wherever these sprinklers are applied is ample evidence of their value. A modification of the system as at present applied suggests itself to me in the use of a motor and pump in place of the roof tank at present in use. The blowing out of a thermostat or other device which now brings the sprinkler into operation could also be made to start a motor and pump, and thus furnish a practically inexhaustible supply of water in place of the limited tank supply now in use. There are, however, numerous recorded instances where these automatic sprinklers have been "too previous," if I may be allowed the expression. In this connection I would ask your consideration of the diagram, Fig. 2, which illustrates a sprinkler system, which, while not automatic in its action, possesses some features of advantage over the automatic system, especially in stores or warehouses which are constantly patrolled, and therefore under surveillance. In this system the pump G and motor F are controlled by the same devices of piston A and magnet B as the system previously described. Connected to the pump and distributed through the several rooms or apartments to be protected, is the system of sprinkler piping H. On each floor, or in each department, if desirable, is situated a valve in a branch from the main piping, controlling the sprinkler system of the floor or apartment. This valve is controlled by a piston A and magnet B, similar to the ones controlling the motor and pump. The several magnets in the building are independently in series with the motor magnet. On each floor, or in any number of places on the floor, are convenient push buttons or switches, C, which, being closed, act to start the motor and pump and at the same time open the valve in any apartment connected with the switch closed. Where desirable, a second system of switches might be arranged which would act to stop the motor and pump and close the valves.

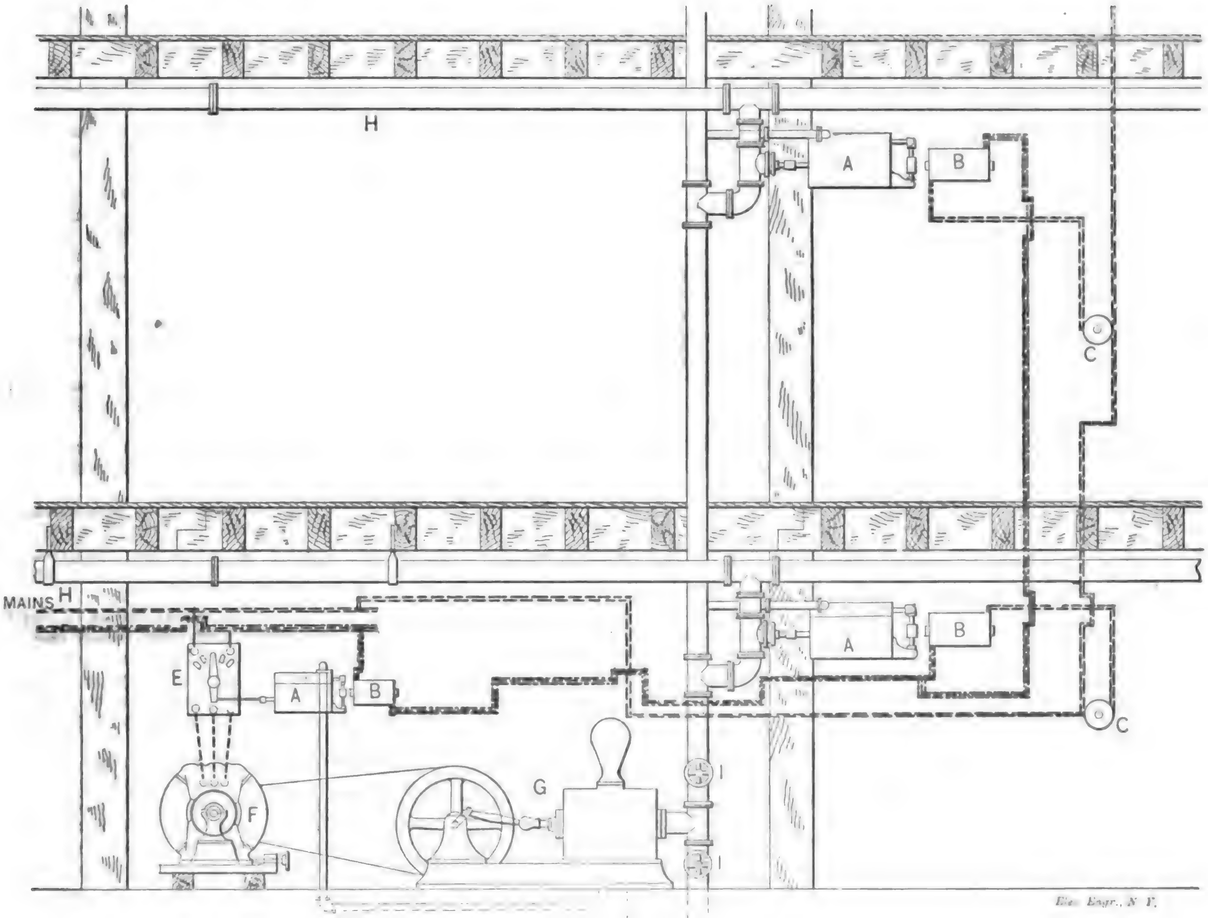


Fig. 2.—Lufkin's Method of Electric Fire Extinguishing.

It seems to me that in a theatre a system of this description would be particularly desirable. There could be located in any number of places about the theatre sets of switches controlling the entire house. On the discovery of a fire in one of the dressing-rooms the sprinkler could be started in the room from any of these several switch boards or in the room itself. In this manner, also, the exits and lobbies could be literally flooded, and thus allow of the harmless escape of the audience, even should the fire practically surround them.

These are some of the possibilities of electricity as applied to the extinguishing of fires, and I submit that, while electricity is making such giant strides in the mechanic arts, its inevitable application as a power for the operation of fire department apparatus is by no means a remote possibility, but will be found an actual necessity.

ELECTROLYTIC THEORIES.[1]

BY PROFESSOR G. F. FITZGERALD, F.R.S.

Electrolysis has been explained on two different theories by Grotthüs and Clausius. As generally received they differ. Grotthüs' theory, as generally given, assumes that the molecules in an electrolyte are both polarized and moved by the electric forces within the liquid. This seems so far untenable that it would appear that double the electric force would double both the polarization and the motion of the molecules, and so should produce four times the electrolysis. The objection, however, assumes that we know the causes resisting the motion, and with proper, and not very improbable, assumptions as to the resistance to motion depending on it and on the polarization, a linear relation between current and electromotive force, *i. e.*, obedience to Ohm's law, seems possible. A modification of Grotthüs' hypothesis in the direction of Clausius' is, however, possible. Suppose that when polarized the molecules *drew one another apart* at a rate proportional to the polarization. This at once makes the relation between electric force and the decomposition a linear one, and so satisfies Ohm's law in the case of small currents. It also so far agrees with Clausius' hypothesis that it explains electrolysis and double decomposition as properties of the same kind. The molecules in a liquid will occasionally be arranged by accident in the proper polarized condition in a closed circuit for drawing one another apart; and if the circuit includes molecules of different kinds, there will result double decomposition. There seem to be very serious difficulties in supposing that uncombined atoms are for any finite time free in the liquid; and the supposition that it is a particular arrangement that is required before exchanges take place and that with this arrangement exchanges take place of their own accord, seems to explain electrolysis and double decomposition without supposing free atoms to exist within the liquid. I have not assumed Prof. Armstrong's suggestion that the proper arrangement for double decomposition is a double molecule; but it seems a likely hypothesis, and one that should be investigated from the chemical, rather than the physical, side.

There are some other phenomena that have been explained upon the supposition that free atoms are gadding about in a liquid. Such are the lowering of the boiling and freezing points by solution of salts, and their effect on osmotic pressure. If dissociated atoms are going about in a liquid as in a gas, it seems impossible but that they must diffuse at different rates; and that this is not observed seems conclusive against the hypothesis, no matter what else the hypothesis may explain. Consider solution simply. Why does chloride of sodium dissolve in water? There must be some strong affinity between the two of a chemical or semi-chemical nature to break up the cohesion of the crystal; and it seems reasonable to assume that this same affinity keeps the molecules of NaCl moving about among the water molecules, so that they diffuse about. Now if the forces drawing them about be independent of the nature of the molecule, most of the phenomena explained by gaseous laws are explained. Pressure of a gas depends, at any temperature, on the number of molecules, and not on their kind. This is Avogadro's law, by which molecular weights are calculated; and if the forces drawing a molecule about in a liquid are independent of the kind of molecule, the very same law of pressure would hold, the pressure forward of molecules of different kinds would depend on their number only, and in the same way as Avogadro's law would enable molecular weights to be calculated. In this connection it is well to state that some bodies may, nevertheless, be much better able to produce pressure than others, because of their being more easily polarized, *i. e.*, turned into an effective direction. A molecule which could be easily turned into an effective direction would be about twice as effective as a molecule which went about in a higgledy-piggledy way; and one would consequently expect electrolytes to produce more, nearly double, the osmotic pressure that other bodies did. As to the changes of boiling and freezing points, they seem explicable by exactly the same hypothesis. The reduction of vapor pressure by molecular affinity of dissolved salt would depend only on the number of molecules of salt if all salts have the same molecular affinity for water; and the same would apply to the change in freezing point. Hence all these phenomena are explained without assuming free atoms, and they are all explained by what can hardly avoid being a *vera causa*, namely, whatever affinities they are that cause solution, which latter is an unexplained phenomenon on the dissociation hypothesis. That it is reasonable to think that the forces keeping the molecules of salt moving about in the water are independent of the nature of the salt, appears from various considerations. In the first place, these forces are in all probability due to the residual affinities of the non-metallic elements. These same forces are probably the cause of crystallization. These are old suggestions. That these residual affinities should be nearly the same for different combinations does not seem at all unlikely.

If a rather shaky argument in favor of its likelihood on mechanical grounds is desired, the following may deserve attention. Suppose a molecule of NaCl, for instance, at rest, or nearly so, in a crystal. Subject it to this affinity. Its velocity, after it has gone a distance, s, will be given by some such relation as $f\, s = \frac{1}{2}\, m\, v^2$. Now, for the sake of temperature equilibrium, with molecules of somewhat similar structure, $\frac{1}{2}\, m\, v^2$ must be the same in all. It seems likely that, at least approximately, the kinetic energy of motion is proportional to the total energy, and that this is the same for each molecular group; if so, the kinetic energy must be approximately the same for different groups. Now, with very dilute solutions s must be nearly the same for different molecules, and if so we get that for temperature equilibrum f must be independent of the nature of the molecule. How this equalization of f for different kinds of molecules comes about may be as follows: Molecules in a liquid move about among one another, but are well within the sphere of one another's attraction, as is evidenced by superficial tension and by the tension to which a liquid can be subject. A very small change in the distance apart of the molecules means, however, a very great change in the forces between them, as otherwise they would be extensible and compressible like gases. It seems likely, then, that when a salt dissolves in a liquid it requires for temperature equilibrium that the distances of the molecules should change by the very small amount required in order that f may become the same for all substances. The very minute change in distance would not sensibly affect s.

1 Communicated to the London *Electrician* by the Secretaries of the Electrolysis Committee of the British Association.

AN UNKNOWN PHILOSOPHER—GAULARD.[1]

BY EMILE GAUTIER.

Under the presidency of Alessandro Volta—a name of destiny—there has just been organized in Italy a club of engineers and scientists who have voluntarily assumed the pious work of organizing a subscription with the view of erecting a statue to the French electrician, Lucien Gaulard.

This act in itself was nothing particularly astonishing.

It was simply natural that the Italians should make a duty and an honor of paying this posthumous tribute of admiration to our countryman and moulding him in bronze, for the sufficient reason that in 1884 he exploited before their eyes and on their account the marvellous discovery of which they had the first fruits.

What, on the contrary, is astonishing, is that they have been permitted to make the start.

But it is chiefly in France that it is true to say "No one is a prophet in his own country." Often it is not even enough to die in order to obtain justice.

Such precisely is the case with poor Gaulard, of whom, I would bet heavily, not nine Frenchmen in a hundred knew even his name.

And notwithstanding all, this illustrious unknown has revolutionized electricity. Not only has he conceived but also *effected* one of the most prodigious industrial miracles of the closing days of the present century, and were History just, it is by the side of Edison that she would legitimately place him.

Is it not to him, in fact, that the entire honor of the first distribution of electric light over great distances really belongs?

It was at Lanzo, upon exactly the same site where the commemorative monument dedicated to his memory by the gratitude of strangers will be erected, that six years ago, at the time of the International Electrical Congress of Turin, the place was unconsciously consecrated by his genius.

Thanks to the apparatus that bears his name (associated with that of only one other—an Englishman—from whom he could always find encouragement and support); thanks to the transformers of Gaulard and Gibbs, of which the technical description would be too long and dry to be set forth here, and whose value needs no demonstration, he succeeded there *upon a circuit of* 80 *kilometres* in feeding 112 electric lamps of the most different systems with the incredible delivery of more than 90 per cent. efficiency.

Never before had an equal distribution of light been made.

The experiment caused a great sensation everywhere, and it was to Gaulard that the jury of the congress, composed of delegates from the academies of the entire world, decreed, without hesitation, the international prize of 10,000 francs, with the "grand gold medal."

This did not prevent, four years later, the unfortunate great man, whose unpardonable crime was that of not being either a magnate or a "*struggle-for-lifer*," from dying at the age of thirty-eight, in the full flower of his maturity, at the Hospital of Sainte Anne, hopeless, insane, his brain exhausted by the fermentation of bitterness.

It was just the moment when, by the cruel irony of fate, his invention took a development that even in his most ambitious dreams, he had never dared to anticipate.

Destiny sometimes has these atrocious refinements of cruelty. Perhaps it is necessary, that, like all new deities, the fairy Electricity should also have her martyrs.

At this very hour one hundred thousand horse-power maintain

1. *Revue de France.*

one million lamps by the use of the methods created by Lucien Gaulard.

In London the single station of Grovesnor Gallery, equipped on this system, generates the current for 40,000 lamps over a circuit of 120 kilometres. It is to the same apparatus that on the other side of the Atlantic, the Westinghouse Company owes its capacity to light 150 American cities.

Here in France, in revenge—excepting only the city of Tours—the invention of the unhappy innovator is nowhere yet in operation.

You see that the transformers (secondary generators) of Gaulard and Gibbs will not be acclimated in France, although everywhere else; that is to say, not until they commence—for progress is never stopped—to be out of date and to grow old.

Not even in his own country does Gaulard receive the tardy reparation made to such other misunderstood geniuses as Denis Papin, Philippe Le Bon, Nicolas LeBlanc, Sauvage, Millet, and "tutti quanti," who were all unable to win the prize at the game of distributive injustice, or to learn the taste of the heady wine of triumph. While the names, infamous forever, of Gabrielle Bompard and Michel Eyraud are now in every mouth, the ignorant, forgetful and skeptical crowd has still to ask with sneering lips, what will rhyme with the echoless name of Gaulard, which not a single municipal council has dreamed of giving to the smallest street.

It will not be on his native soil but in the land of exile—the only hospitality, as it seems, for unrecognized talent—that the "outlaw" will have his statue, to which, perhaps, there will not a single Frenchman be found to have contributed.

Ah! the brutal proverb is right, "No one is a prophet in his own country"—above all when that country is called France.

THE LONDON AND PARIS TELEPHONE CABLE.

Telephonic communication between London and Paris is now merely awaiting the consent of the French Government. Mr. Preece stated at the Newcastle meeting of the British Association that experiments had been made to ascertain under what circumstances such communication was possible; and in February, 1887, he communicated to the Royal Society a paper in which it was stated that, taking the resistance of a conductor in ohms, and its capacity in microfarads, telephonic communication is good, when the product of these is 5,000; when it is 10,000 talking is just possible, and the limit is reached at 15,000, when no articulation is audible. Experiments have been made with telephones on the cables between Dover and Calais, between Holyhead and Dublin, between South Wales and Wexford; and from the results of these, the officials of the Post Office are perfectly satisfied that they can build a line between the capitals of the two countries through which telephone communication will be not only possible, but highly satisfactory.

The present cable between Dover and Calais is quite unsuitable for the purpose, both on account of its high resistance and its capacity. The requisite details of the new cable and the land lines have been worked out, and the results of the calculations have been compared with the tests recently made upon a line from Baldock in Hertfordshire, through London to Worcester. In this experiment, which was conducted with the view of determining the constants of the proposed line to Paris, two copper wires were employed, and no less than 27 miles of the circuit was through the underground system of the postal telegraphs in London. The communication through this line by telephone was very good, and confirmed in a very satisfactory manner the calculations which have been made. The telegraphic communication between London and Paris has increased very considerably during the past few years; and as it is necessary to make some extensions, it has been considered that the new line should be one through which telephony could be carried on.

A MOVEMENT TO CONSOLIDATE THE CARBON INDUSTRIES.

RUMORS have been current as to new "deals" in the carbon industry, and it has been stated that the Thomson-Houston Company have secured control of the National Carbon Co. A recent report for Cleveland is as follows:

The National Carbon Company is established in a big brick building at the foot of Willson avenue. The officers are: President, H. W. Lawrence; secretary, H. E. Hackenburg; treasurer, Webb C. Hayes; superintendent, J. H. Osborn.

It is stated on the best of authority that the majority of the capital stock was sold to the Thomson-Houston Company several weeks ago. An outside estimate of the purchase price placed the amount at about $150,000. Messrs. Lawrence and Hayes retain financial interests and an active connection with the business.

The Standard Carbon Company, which has been much sought by the Thomson-Houston Company, has a large plant at Hamilton street and the Cleveland and Pittsburgh Railway. The officers of the company are: President, Hon. D. A. Dangler; vice-president, J. B. Crouse; secretary and treasurer, W. G. Smith; superintendent, H. A. Tremaine.

The authorized capital of the company is $500,000, but of that amount only $150,000 has been issued. Several conferences have been held between Mr. Dangler and representatives of the Thomson-Houston Company, but they have been unable to agree upon terms. Negotiations have now been suspended temporarily, but it is not unlikely that they will be resumed and that the plant will pass to the Eastern company. They were anxious to secure the property and proposed to retain Mr. Crouse and Mr. Smith. Mr. Dangler would be too busy with his other interests to take part in the management if the plant was secured by the men from the East. The chief argument of the Thomson-Houston people was that with the plant in the charge of their company one-quarter of the stock would be nearly as valuable as the whole under independent management. It was shown that the company would practically control electric lighting, and would, therefore, be the main consumer of the carbon points. The companies established in the various cities would have a natural inclination to buy supplies from the parent company, it was said, and the various factories would naturally experience a boom.

There are four carbon manufactories in Cleveland, the Brush Electric, National, Standard and the Globe. Those four concerns manufacture 60 per cent., or 54,000,000 of the 90,000,000 carbons used annually in the United States. A factory owned by the Thomson-Houston Company, at Fremont, turns out ten per cent. of the total production, but it is usually accounted a part of Cleveland, and that city is given credit for 70 per cent. It is said that the output of the Globe Company is about 5,000,000 carbons yearly. There are two factories in St. Louis and one in Pittsburgh. For years the Brush Company stood at the head of the business, but other companies entered the field, and during the rapid development of the business they secured important positions. From the time of the introduction of electric lighting, however, Cleveland has been in the lead and has practically controlled the production.

MANUFACTURE OF VERMILLION BY ELECTROLYSIS.

In a wooden vat, one metre in diameter and two metres deep, circular plates 15 centimetres wide are placed against the sides, and on these the mercury is exposed, one centimetre deep. These plates are connected with the positive pole of a dynamo. At the bottom of the vat is a sheet of copper electroplated with iron, and connected with the negative pole. The vat is filled with a solution of 8 per cent. of nitrate of ammonia, and 8 per cent. of nitrate of soda. A worm, pierced with holes, supplies a constant and regulated current of sulphuric acid; the excess of gas escapes by a tube projecting from the lid. A screw agitator keeps up a thorough mixture in all parts of the liquid. When the current passes it immediately forms a precipitate of red sulphide of mercury. Attempts have been made to dispense with the current of sulphuric acid by making up the bath with:—Water, 100 litres; nitrate of ammonia, 8 kilos; nitrate of soda, 8 kilos; sulphide of soda, 8 kilos; sulphur, 8 kilos. Under these conditions one need only add sulphur and mercury to extract at the end of the operation vermillion which rivals that which can be obtained by sulphate of ammonia.

LAYING OCEAN CABLES.

Herbert Laws Webb—a nephew of Mr. W. H. Preece, F.R.S., the Chief Electrician of the British Postal Telegraphs, and a son of F. C. Webb, C.E., who was one of the pioneers in sub-marine cable engineering—will contribute to the September number of *Scribner's Magazine* a most interesting article entitled "With a Cable Expedition," which describes (in the form of a personal narrative of an expedition in which he took part) the whole process of laying a deep-sea cable—the life on ship-board among the very original men who form the expert staff in such work, the curious machines devised expressly for cable laying, the great ocean surveys, in which submarine islands and mountains are discovered, the excitement of a break, and the weary disappointment of grappling for the lost cable. The pictures are from photographs made on the cable ship "Dacia," of the Silvertown Company, expressly for this magazine. Mr. Webb is now electrician on the staff of the Metropolitan Telephone Company, in this city.

ELECTRIC RAILROAD EARNINGS AT WINSTON, N. C.

A very interesting statement comes to hand of the earnings at Winston, N. C., of the Sprague road in that town. The road has been in full operation for more than a month without any charge for repairs. The road now has three cars running and shows an average income of $68.76 per day, or nearly 1400 passengers per day for the three cars. The average car mileage is 114 miles per day.

CONNECTICUT MOTOR CO.—At a special meeting of the stockholders of the Connecticut Motor Co., it was voted to increase the capital stock from $30,000 to $40,000, the present stockholders to be given the preference in subscribing for the increase until Oct. 1.

CORRESPONDENCE.

CHICAGO.

The Calumet Electric Lighting Co.—A New Electrical Factory.—Electric Railways at Springfield, Ill.—A High Efficiency Incandescent Lamp.

THE Calumet Electric Lighting Company, of which F. H. Watriss is the president, have asked for and obtained a permit from the Department of Public Works to erect poles and place electric lights on all streets from Eighty-seventh to One Hundred and Sixth, in South Chicago, the company having obtained an ordinance from that village before it was annexed to Chicago.

Rumors are current that some prominent men in electrical circles of Chicago and vicinity are about to start a new Western enterprise, and contemplate the erection of a large factory for the manufacture of small electrical specialties on an extensive scale, in Oaklawn, which is one of the South Side outlying suburbs of Chicago.

Electric street railway matters are receiving considerable attention just now in Springfield, Ill., and the Springfield City Railroad Company had a big time recently in opening their new extension to South Springfield. All the citizens are up in arms with the electric company against the Board of Aldermen and City Council, and say they will have tracks placed on any street in the city they please, in spite of the aldermen. This decisive action in favor of a corporation who have risen above horses and mules shows the strong favor in which electrical rapid transit is held by the public.

The question of obtaining lamps of higher voltage, greater efficiency and increased life, is one of the most important in the electrical industry. An extraordinary advance in these features is claimed for a new lamp which will shortly be placed upon the market, and which is now being tested for the inventors by the National Engineering Bureau of Chicago. A life test has been commenced of the new lamp, which, it is stated, absorbs in no instance more than 2 watts per candle in the small sizes, the larger sizes being even more efficient. A 300 candle power lamp has been burning with an efficiency of 1¾ watts per candle, which brings it into direct comparison with arc lamps for efficiency. Commercially successful lamps of 200 volts can be made. A comparative test is now progressing on a 50 volt circuit, and the statement is made that this new lamp is only using nine-tenths of an ampere, whilst the least amount of current absorbed by any of the others is 1.06 amperes, the candle power measured on the photometer being the same in all cases. The lamps on this test have now been running 200 hours without the slightest depreciation in the appearance of the new lamp. In taking the readings three different style of ammeters and voltmeters are employed, and the readings are noted by the managing engineers of the bureau and several responsible college professors. It is needless to say that if these lamps fulfil in practice the claims which are made for them, they will work many changes in the present methods of distribution of incandescent lighting.

CHICAGO, Aug. 23, 1890.

The Lincoln Park Electric Fountain.—Rapid Transit Schemes.—Fire Alarm Telegraph Litigation.

THE electric fountain at Lincoln Park, which was presented to the Lincoln Park commissioners and dedicated to the people of Chicago by Mr. Yerkes, is now completed and in regular operation. It is patterned after the great prismatic fountain which was one of the leading attractions of the recent Paris Exposition, but is said to be larger and capable of producing even grander and more striking effects. It will run between the hours of 8 and 10 o'clock with slight intermissions. The working of the fountain is pronounced quite a success and is a magnificent sight. The jet and spray effects are very numerous and effective. Underneath the fountain is a cellar in which the electric light plant is situated. As the streams spout, rays of light play in the same direction as the streams. There are all the colors of the rainbow, sometimes all turned on together, and sometimes the jets are all of the same hue. Red, green, violet, blue and pure white are seen in succession, and then all together. The white and green tints suggest an ordinary waterfall under a strong light. The whole fountain is a masterpiece of ingenuity and a most imposing and appropriate structure, adding considerably to the attractions of the park.

An incendiary fire occurred at McVicker's Theatre, about 2:30 A. M., Tuesday morning last. The building was completely gutted and all but the outer walls are in ruins. This theatre was very extensively equipped with electric lighting and some of the scenic effects gotten up in various productions by its agency have been remarkably striking. The big building, however, is to rise immediately Phœnix like from its ashes, and will be beautified and improved in every possible way, and electric lighting and electric motors for cooling, ventilating, and power purposes will play no mean part in these innovations.

Among the new rapid transit schemes now in contemplation in Chicago is the Chicago and Jefferson Urban Transit Company, which has just been incorporated at Springfield, to build and operate lines of street railway in the city of Chicago and neighboring towns, which are to be run by electric or other motor power, and it is to be sincerely hoped, both on account of good service and financial reasons, that no other power than electricity will be employed for suburban transit of the class required. The capital stock is $1,000,000, and the incorporators are John Johnston, Jr., Henry Vannatta, Frank H. Dickey, Frank H. Baker, Thomas P. Keefe, Charles B. Hosmer and Edward D. Hosmer. One of the above incorporators states that the company will start work within a few weeks. It is proposed to run a line of cars through the towns of Almira, Hermosa, Cragin and Galewood, beginning at North and Arlington avenues; also a line on Grand avenue, running northwest to the end of the old city limits. The decision with regard to motive power has not yet been made.

A bill has been filed in the United States Circuit Court, to restrain the city of Aurora, Ill., from infringing improvements in non-interfering fire alarm boxes by the Gamewell Fire Alarm Telegraph Company, of New York. The original patent was issued to Joseph W. Stover, Feb. 14th, 1882, and was assigned to complainant in May last.

CHICAGO, August 30, 1890.

PITTSBURGH.

Electric Railway Notes.—Tower and Mast Arm Lighting.

THE Squirrel Hill Railway Company, of this city, which recently fell into the hands of a receiver, is to be provided with means for the completion of its line. The receiver has just asked permission of the court to borrow five thousand dollars to apply to the work, and this has been granted. There is still a snag in the way, however. As laid out, the Squirrel Hill line encroaches on the domain of the new Schenley Park, and the city is disposed to object very vigorously to this encroachment. A slight change will probably have to take place in the route.

At first, the people of Allegheny were pretty well pleased with their new tower system of electric lighting, but recently there have been a good many complaints to the effect that the illumination is not evenly distributed. The City Council has decided to make an addition to the equipment in the shape of ten towers and one hundred mast arms. It is thought that once these new towers and arms get in use, the dark places of the city will be few.

The Dravosburg, Mendelssohn and Elizabeth Electric Street Railway Company was chartered at Harrisburg, Pa., a few days since. This company will operate an electric line seven miles in length, which will run between the three towns whose names appear in the company's title. The capital of the concern is forty-five thousand dollars. The directors, who are all residents of McKeesport, Pa., are James E. White, John Haben, John K. Skelley, James L. Devenney and Joseph A. Skelley.

The Pittsburgh Traction Company, operating the cable system between Pittsburgh and East Liberty, and the Duquesne Traction Co., which is constructing an electric line between Pittsburgh, East Liberty and Wilkinsburg, bid fair to become active rivals. The Pittsburgh Company is said to have determined to reduce its five cent fare to three cents so soon as the Duquesne Company shall be in position to compete. The lines are parallel for a considerable portion of the distance between Pittsburgh and East Liberty. The Duquesne Company says that there is business enough for both lines at a reasonable price, and it looks with some distrust on the reputed intention of the other company to come down to three cents. The feeling between the two companies seems to afford the public no cause for sorrow. It is altogether probable that should a three cent fare come, it will be received with good grace by the patrons of the line.

The new Pittsburgh incline railway which runs from South Twelfth street, Pittsburgh, to the summit of Mount Washington, has just been put in operation. This incline is equipped in the best possible fashion both as to machinery and cars. The engines are of the most approved kind and the cars are in every way convenient and comfortable. This incline is to be run in connection with the electric line of the Birmingham Traction Company.

The East End Electric Light Company, of this city, is enjoying great prosperity. The demand for light in the district covered by the company is steadily growing, and hence it is necessary to make frequent additions to the lines and dynamo capacity. Otherwise, the East End Company would be paying big dividends.

PITTSBURGH, Aug. 23, 1890.

Mr. Byllesby's Return.—Electric Railway Work.—Lighting at McKeesport and Washington.

VICE-PRESIDENT and General Manager H. M. Byllesby, of the Westinghouse Electric and Manufacturing Company, returned on the steamer Majestic last week from Europe, where he has been superintending the erection of the branch works of his company in London.

The borough council of Washington, Pa., has advertised for bids to light the streets of the town by electricity. This contract is now in the hands of a natural gas company, but that corporation refuses to supply that illuminant any longer because it is wasted too much.

A new switch board is being put up in the power house of the Pleasant Valley Electric Railway Company, which is said to be quite a unique affair, there being no other of its kind in the country. The "board" consists of brick and terra cotta lumber covered with cement, a composition which greatly eliminates any fear of fire.

The McKeesport Light Company is contemplating many improvements and enlargements at its plant in McKeesport. The station has apparatus of 2,000 lights capacity, and the company expects to double the plant within the next six months.

Two Pittsburgh lads are just now reveling in the idea that they have invented an electrical device which will supersede the present system of overhead trolley wires. The lads are only twenty years of age and it is to be hoped that their ardor will not be cooled off too soon. The invention consists of a series of iron boxes buried in the ground along the car tracks, at a distance of a car's length. Then there is an iron rod or beam attached beneath the truck of the car in a manner so as to slide over the tops of the iron boxes. By this means they expect to establish connection for the current. The boys have applied for a patent.

PITTSBURGH, Aug. 30, 1890.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.
Anonymous communications cannot be noticed.
The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.
In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.
Sketches and drawings for illustrations should be on separate pieces of paper.
All communications should be addressed EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

EFFICIENCY OF TRANSFORMERS.

[136.]—In the August 6 issue of your paper I see a criticism of Prof. Ryan's and Messrs. Humphrey and Powell's papers on the efficiency of transformers. Having worked in the same line, theoretically and practically, in reading these classical papers I was very much interested to find experimental proof of the different phenomena I tried to deal with by mathematical methods. And I was all the more glad to see Mr. Swinburne's elucidating remarks on those papers, although I cannot agree with him. Thus, for instance, he says in his letter, that "with no Foucault-currents, the maximum primary current on open circuit necessarily corresponds with the zero of the E. M. F.," and because, in the diagrams given in the papers mentioned above, the difference of phase between primary current and E. M. F. is shown less than 90°, he thinks these curves look inaccurate.

Now, first it is a questionable matter to refute empirical data by mere theoretical reasoning; and then we can prove, in a very simple manner, whether this assertion is true. Suppose Mr. Swinburne's assertion were true, that the primary current on open secondary circuit reaches its maximum at the instant when the E. M. F. is zero; then this is certainly true also for the simplest harmonic wave of the E. M. F., which is following the sine law. But when we leave out of consideration the influence of hysteresis—and we can very well imagine a transformer, which contains no iron, and therefore has no hysteresis—then it is obvious, and can be shown by a simple analytical reasoning (which I omit here, having given it elsewhere [1]), that the electric current follows the sine law, too, no matter whether it produces secondary and Foucault currents or not. According to Mr. Swinburne's assertion the difference of phases between current and E. M. F. = 90°; therefore the energy consumed by the current is:

$$W = \frac{E\,C}{2}\cos 90^\circ = 0.$$

Where E = maximum E. M. F., C = maximum current.

But, nevertheless, this current produces heat, that is, energy, and we would have, therefore, a production of energy without consumption—that is, *perpetual motion!*

In reality, for a sine-wave of E. M. F. which meets no Foucault currents, and can be represented by the equation:

$$e = E \sin \frac{2\,\pi\,t}{T},$$

where E is the maximum E. M. F., and T the time of one period, the current is given by:

$$c = C \sin\left(\frac{2\,\pi\,t}{T} - \omega\right),$$

where:

$$\tan\omega = \frac{2\,\pi\,n^2\,10^{-8}}{\rho\,R\,T}$$

and:

$$C = \frac{E}{\sqrt{R^2 + \frac{4\,\pi^2\,n^4\,10^{-16}}{\rho^2\,T^2}}}$$

where:

R = electric resistance,
ρ = magnetic "
n = number of primary turns.

ω is therefore always $> 0^\circ$ and $< 90^\circ$, but approaches 90° the more, the smaller ρ is: that is, the better the magnetic circuit of the transformer is, but can never reach 90°.

That means "*the maximum of current must necessarily occur before* the E. M. F. reaches zero." This is proved by the figures given in the above mentioned papers.

Secondary and Foucault currents advance the phases of the primary current, and thereby decrease this angle of lag ω still more, because also drawing energy from the primary source.

Furthermore, I cannot see that the Foucault current curve must be similar to the primary current curve, as Mr. Swinburne says. According to my notions the Foucault currents are due to electromotive forces, set up by the changes of the magnetism in the iron and the other conducting parts of the transformer, exactly in the same manner as the secondary E. M. F. is produced in the secondary circuit. Indeed, they are true secondary currents, and the only difference between them and the secondary current proper is, that they cannot (yet) be used.

Hence they must have the shape *not* of the primary current, but of the secondary E. M. F., with only those differences which are due to their different positions in the magnetic field, and the different amount of magnetic leakage they meet with.

Therefore, they must be expected to lag behind the primary current by more than 90° and less than 180°, and this angle of lag must be greater or smaller, according to the greater or smaller amount of secondary and Foucault currents induced.

That the Foucault currents sometimes give back energy to the primary circuit, I cannot find astonishing either, knowing that the secondary currents do so, and that the Foucault currents are only a special kind of secondary current.

As regards the assumption, made by Prof. Ryan, that the electric resistance of an incandescent lamp for *continuous currents* is the same as for *alternate currents of the same effective value*, although I do not believe this to be absolutely correct, it is certainly so nearly true, that the error caused by it must be much beyond the limits of sensitiveness of our instruments. A very interesting mathematical treatment of this question, especially relating to the Cardew voltmeter, by Dr. C. Cranz, can be found in the *Zeitschrift für Mathematik und Physik*, edited by Prof. Schloemilch, Dresden, Germany, volume 34, page 92.

CHARLES STEINMETZ.

YONKERS, N. Y.

1. *Centralblatt fuer Elektrotechnik*, Munich, 1889, p. 171, vol. XII., and *Elektrotechnische Zeitschrift*, Berlin, 1890, p. 185.

THE DISTRIBUTION OF LIGHTS IN TEXTILE FACTORIES[1].

The lighting for textile industries is here considered, first, because there exists none other which has need of so powerful lights; and secondly, because it has been thoroughly studied in all its details, and since the type of factories is nearly the same in all countries, all of them may, therefore, be compared among themselves. The rooms are large, and they contain a certain number of similar machines. The walls and ceilings are assumed to be white. For spinning, the minimum number of lamps should be one 12-ampere arc for 180 to 200 square metres (say 230 square yards, or 15x15 yards). The maximum for a 9 or 10 ampere arc should be 80 to 100 square metres (say 110 square yards, or 10½ x 10½ yards). These areas are for high rooms and for spinning unbleached or clear colored yarn. For weaving, the minimum is a 12-ampere arc for 120 square metres (133 square yards, or 11½ yards square). For white, unbleached or clear colors, a good light is given with a 10-ampere arc over an area of 75 to 80 square metres (93 square yards, say 9½ yards square). But for black, and especially for dark colors, which must be distinguished thread by thread, some workers are not satisfied unless 10-ampere arcs are placed 7 metres (23 feet) from each other, that is 49 square metres (59 square yards) for each lamp. In general it is not advantageous to employ lamps of less than 8 or 9 amperes; 10 amperes gives a good light for industrial use. When the rooms are small, or the lighting is not evenly divided, 6 amperes may be used. For blacks and dark colors twice the amount of light must in general be used as for white or light goods, and even then the eye will be fatigued. In weaving light goods by glow lamps, a 10-candle and even an 8-candle lamp may be used for lighting

1. *L'Electricien.*

two looms for unbleached stuff, and, on the other hand, for colors, two 16 candle lamps to a loom; or, if it is rather long, two 20-candle lamps are needed. That is exceptional, but it may be said that in most cases one 16-candle lamp will suffice for two looms. For arc lighting it is not a question of the number of looms, but the area which has to be lighted; it is, in fact, a general illumination. The room must be lighted, and all that is in it, without troubling about any particular machine or part on which the worker is occupied. Arc lamps obviously cannot well be employed in small rooms. For outside work in courtyards and the railway goods yards, an excellent effect is produced by lamps of 15 amperes, placed at 12 metres (40ft.) high, or, in case of need, lamps at 12 amperes at 10 metres (33ft.) high; but it is not advisable to use less than this. These figures have been arrived at by practical experience in Belgium and Germany, and it is because they have been departed from in lighting the streets of Paris that the illumination there tires the eyes without making things properly visible. There is an unnecessary number of lamps placed too low, and of too feeble an intensity; moreover, this arrangement is more expensive.

FINANCIAL MARKET.

QUOTATIONS ON ELECTRICAL STOCKS.

Mr. F. Z. Maguire, Electrical Securities, of 18 Wall street, this city, reports the following quotations of August 29 from New York, Boston and Washington:—

NEW YORK.

	BID.		BID.
W. U. Tel. Co...............	83¼	Edison Gen. Elec. Co.....	104
American Tele. & Cable...	83	Edison Gen. Co. Def'd.....	....
Centl. & So. Amer..........	157	Consol'd Elec. Lt. Co.....	60
Mexican..........	205	Edison Illn'g Co. N. Y.....	....
Com. Cable Co.......... ...	....	U. S. Elec. Lt. Co..........	85
Postal Tel. Cable...........	39	North. Am. Phon'gph......	....

BOSTON.

	BID.		BID.
Thomson-Houston..........	49¼	Ft. Wayne Co..............	12
" Pref'd.....	25¼	Am. Bell..................	224
" Series C.....	12	Erie......................	49¼
" " D.....	6	New England.............	51¼
" Int. Co.....	....	Mexican..................	.85 cts
Thomson Welding Co......	..	Trop. American..........	..
Thomson Eu. Welding.....	87	Edison Phon'gph Doll.....	....

WASHINGTON.

	BID.		BID.
Penna. Telephone..........	26	U. S. Elec. Lt. (Wash).....	150
Ches & Pot. Telephone.....	74*	Eck. & Sold. Home Elec. Ry..................	69
Amer. Graphophone.......	17¼		

*Ex. Dividend.

PITTSBURGH.

	BID.
Westinghouse Electric and Manufacturing Co.....................	38¼

REPORTS OF COMPANIES.

STOCKS AND BONDS.

MONROE, S. C., is to vote on the issuance of $25,000 of bonds for an electric light plant.

DENVER, COL.—Colwell, Johnson & Co., of Providence, R. I., are offering for sale $18,000 of the 6 per cent. bonds of the Denver Consolidated Electric Co.

CLINTON, MASS.—The capital stock of the Clinton (Mass.) Gas Light Company has been increased to $60,000, from $35,000, and the new issue was immediately disposed of at par—$500 per share. The money thus raised is to be expended in the construction and equipment of the Company's new electric light station now under way.

BROOKLYN, N. Y.—The Edison Company proposes to increase its capital stock from $600,000 to $1,500,000 and to build three new stations. The company is already supplying 20,000 lights, or twice as many as were expected within the first year of operation. The present stockholders will be permitted to subscribe for 9,000 shares at par, but 20 per cent will be repaid to them in the form of a dividend. No regular dividend has yet been declared, but the company is on a paying basis and the stock is selling at its full value.

MEMPHIS, TENN.—A dispatch from Memphis, Tenn., concerning the projected mammoth electrical railway system, says: "C. B. Holmes, of Chicago, to-day made the final payment of $537,000 necessary to close the deal and assume control of all the street car lines of Memphis." The entire street railway system of Memphis comprises some 65 miles of road.

NEW YORK CITY.—L. Fitzgerald, president of the Mercantile Trust Co., trustee, gives notice that on the 1st day of September, 1890, it will have the sum of twenty thousand dollars in the sinking fund provided for under a certain mortgage to it as trustee, dated May 24, 1888, and an agreement dated November 1, 1888, both executed by the Metropolitan Telephone and Telegraph Company, and it invites proposals for the sale to it of bonds secured by said mortgage at a price satisfactory to the Metropolitan Telephone and Telegraph Company, at a rate not exceeding par and ten per centum premium.

THE DALLAS (TEXAS) TRACTION CO. has filed a mortgage upon its property to the Fidelity and Safe Deposit Co., of Philadelphia, Pa., to secure bonds amounting to $1,250,000. A Philadelphia syndicate purchased recently for $750,000 a controlling interest in the stock of the Dallas Consolidated Street Railway Co. Out of this deal grew the Consolidated Traction Co., with $1,250,000 paid-up capital. They went immediately to work to issue thirty-year six per cent. bonds, as above, the proceeds to be spent in improving and extending the system. One of the first moves will be to change the entire system of road, being 25 miles in operation and several miles under construction, to electric power.

DIVIDENDS.

NEW YORK CITY.—Coupons of the 1st mortgage 5 per cent. bonds of the Edison Electric Illuminating Co. will be paid on and after Sept. 2.

ELECTIONS.

THE CONSOLIDATED ELECTRIC LIGHT CO., of New York, will hold its annual meeting on September 17 at 32 Nassau street. The transfer books close September 1.

INVENTORS' RECORD.

Patents issued Aug. 26.

Alarms and Signals:—*Non-Interfering Signal-Box*, W. E. Decraw, 434,922. *Electrical Watchman's Clock*, H. S. Park, 435,185. *Electric Alarm for Clocks*, W. H. Deane, 435,213.

Conductors, Conduits and Insulators:—*Insulator*, C. O. Muehlberg, 434,992. *Automatic Disconnector for Overhead Conductors*, A. L. Jonhston, 435,098.

Distribution:—*Means for Distributing Electric Energy*, S. Z. de Ferranti, 435,114. *Regulation of Electric-Arc Light Circuits*, D. Higham, re-issue, 11,108.

Dynamos and Motors:—*Dynamo-Electric Machine*, W. F. Collins, 435,015. *Generator for Electric-Engine Circuits*, C. J. Van Depoele, 435,261. *Contact-Brush for Dynamos*, E. Franklin, 435,296. *Automatic Current-Regulator*, R. Thury, 435,332.

Galvanic and Thermo-Electric Batteries:—*Galvanic Battery*, C. J. Hubbell, 435,346.

Lamps and Appurtenances:—*Hanger for Incandescent Lamps*, P. J. Chassagne, 434,917. *Incandescent-Lamp Socket*, F. G. Rockwell, 435,024. *Cut-Out for Electric Lamps*, W. G. Bremer, 435,029. *Incandescent-Lamp Socket and Key*, W. F. Smith, 435,047. *Cut-Out*, W. F. Smith, 435,048. *Cut-Out for Electric Lamps*, W. F. Smith, 435,049. *Guard for Electric Light Globes*, R. M. Gardiner, 435,116. *Electric Cut-Out*, C. Heisler, 435,223. *Electric Arc Lamp*, E. Rothlisberger, 435,248. *Extension Electrolier*, J. T. Robb, 435,368.

Medical and Surgical:—*Electro-Magnetic Therapeutic Chair*, F. H. Brown, 435,376.

Metal-Working:—*Electric-Forging Machine*, G. D. Burton, 435,110. *Electric Bar-Heating and Feeding Apparatus*, G. D. Burton, 435,111. *Reciprocating Electric Hammer*, C. J. Van Depoele, 435,264. *Method of and Apparatus for Welding by Electricity*, C. L. Coffin, 435,283. *Process of Heating Metals by Electricity*, C. L. Coffin, 435,284.

Miscellaneous:—*Ceiling Fuse-Block*, H. A. Fitch, 434,925. *Electric Connector*, E. L. Orcutt, 434,943. *High-Resistance-Shunt Compound*, W. G. Bremer, 435,030. *Electric Switch*, C. H. Herrick, 435,093. *Fuse-Block*, N. S. Possons, 435,102. *Electric Switch*, J. W. Battershall, 435,132. *Electric Switch*, J. A. Norton, 435,152. *Feeding and Justifying Mechanism*, J. A. Watson, 435,338. *Articulated Electro-Magnet*, F. H. Brown, 435,343.

Railways and Appliances:—*Gearing for Electrically-Propelled Vehicles*, N. S. Possons, 434,949. *Section-Insulator for Overhead Electric Conductors*, E. Thomson, 434,961. *Motor for Street Cars*, W. H. Patton, 434,993. *Trolley for Electro-Motor Cars*, S. D. Cairns, 435,011. *Electric-Lighting System*, A. H. Bauer, 435,084. *Electric Signal for Cable Railways*, S. J. Jacobs, 435,097. *System for Electric Circuits*, F. Stitzel, 435,105. *Trolley or Contact*

Support for Electric Cars, L. Atwood, 435,166. *Electric Device for Preventing Accidents on Railways*, G. Thew, 435,259. *Structure for Supporting and Insulating Suspended Bare Conductors*, C. J. Van Depoele, 435,262. *Electric Railway Conduit with Tubular Conductor*, C. J. Van Depoele, 435,263. *Automatic Electric Train Signal and Controlling Device*, W. H. Wilson, 435,340.

Telegraphs:—*Autographic Telegraph*, H. Etheridge, 435,293.

Telephones and Appliances:—*Combined Mouth-Piece for Acoustical Instruments*, H. C. Demming, 435,055. *Automatic Telephone Connector*, W. H. Ford, 435,295. *Telephone-Tablet*, W. S. Mendenhall, 435,314.

Patents issued August 19.

Alarms and Signals:—*Electric Push-Button*, P. Hathaway, 434,596. *Portable Electric Signaling Device*, P. Pearson, 434,835. *Heat-Alarm*, Anthony Iske and Albert Iske, 434,872.

Conductors, Conduits and Insulators:—*Apparatus for Coating Wire*, C. J. Goodwin, 434,866. *Electric Insulator*, S. Oakman, 434,879. *Electric Conductor*, W. A. Phillips, 434,885.

Distribution:—*Electric Power Transmission*, E. Thomson, 434,488. *Electric-Power System*, E. Thomson, 434,489. *System of Electrical Distribution*, H. E. Walter, 434,614.

Dynamos and Motors:—*Electric Generator*, T. A. Edison, 434,586. *Dynamo-Electric Machine*, J. B. Entz, 434,590. *Multiple-Circuit Electric Motor*, C. J. Van Depoele, 434,816.

Galvanic and Thermo-Electric Batteries:—*Thermo-Electric Battery*, H. B. Cox, 434,427. *Thermo-Electric Generator*, H. B. Cox, 434,428, 434,429 and 434,500. *Thermo-Electric Battery*, T. A. Edison, 434,587. *Galvanic Battery*, W. M. Fink, 434,593. *Thermal Battery*, Hugo Mestern, 434,640.

Lamps and Appurtenances:—*Tower for Electric Lighting*, D. Maxwell, 434,639.

Measurement:—*Electric Meter*, J. Cauderay, 434,501. *Volt or Ampere Meter*, R. Eickemeyer, 434,557. *Device for Measuring the Intensity of Magnetic Currents*, R. Eickemeyer, 434,558.

Medical and Surgical:—*Electric Belt and Appliances*, R. E. Williams, 434,746.

Metallurgical:—*Magnetic Ore-Separator*, T. A. Edison, 434,588.

Metal-Working:—*Electric Welding Clamp*, H. Lemp, 434,450. *Method of Electric Welding*, Russell Robb, 434,468. *Process of and Apparatus for Forming and Welding Metals by Electricity*, E. Thomson, 434,530. *Induction-Discharge Protector for Welding Apparatus*, E. Thomson, 434,531. *Process of Electric Welding*, E. Thomson, 434,532.

Miscellaneous:—*Electric Valve-Closer*, L. Mellett, 434,671. *Contact-Box*, F. A. Wessel, 434,853. *Binding-Post*, G. J. Scott, 434,892. *Electric Switch*, 434,899.

Railways and Appliances:—*Apparatus for Transferring Electric Car Batteries*, F. G. Corning, 434,579; 434,580; 434,581; 434,582 and 434,863. *Propelling Mechanism for Electric Vehicles*, T. A. Edison, 434,589. *Trolley for Electrically Propelled Cars*, W. L. Stevens and E. J. Westcott, 434,682. *Electric Railway System*, C. J. Van Depoele, 434,684. *Alternate Current Electric Railway Train System*, C. J. Van Depoele, 434,685. *Electric Railway Train System*, C. J. Van Depoele, 434,686. *Electric Railway System*, C. J. Van Depoele, 434,687. *Electric Railway*, A. Gorton, 434,827. *Electric Railway*, R. M. Hunter, 434,871.

Secondary Batteries:—*Secondary Battery*, T. H. Hicks, 434,444. *Electrode for Batteries and the Method of Making the Same*, D. Pepper, Jr., 434,457. *Method of Making Secondary Battery Plates*, D. Pepper, Jr., 434,458. *Secondary Battery Plate*, W. B. Hollingshead, 434,869.

Telegraphs:—*Telegraph Relay*, T. A. Edison, 434,585. *Recording Telegraph*, J. B. Odell, 434,880. *Printing Telegraph*, J. B. Odell, 434,881.

ELECTRIC LIGHT FIXTURES IN THE FIFTH AVENUE THEATRE.

Mr. H. C. Miner has just refurnished the Fifth Avenue Theatre and with his usual enterprise and judgment he has put in the electric light. The massive chandelier which hangs in the lofty dome of the theatre is one of the main ornaments of the house. It was built by I. P. Frink, of this city, and cost Mr. Miner $1,500. It measures thirty feet from the brass ball at the end of stem to the plate at the upper extremity of the stem, and weighs 800 pounds. It contains 262 lights, gas and electric. The gas burners are made to resemble candles. The electric lights are incandescent lamps. It is proposed to light the house by electricity, the gas being reserved for supplementary purposes in any very special illumination. The lights can be used finely for scenic display, as many effects can be obtained by colored combinations. The lower circle contains fifty-six gas and fifty-six electric lights. It is surmounted by a silvered glass reflector. The gas will be lighted by electricity, three wires connecting with lights at equal distances from each other in the circle. Above this circle and the reflector are ten clusters of lights, each made up of six gas burners surrounding three electric lamps. Six feet above this circle of clusters is still another of ten clusters, each made up of four gas lights surrounding two electric lights. The chandelier is richly ornamented with brass, and the stem and pipes are silvered over or bronzed. The chandelier can be raised and lowered at will.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

NEW WESTINGHOUSE PLANTS.

The Westinghouse Electric and Manufacturing Company is now occupied with the installation of a twenty-five light plant at Galveston, Texas.

The Westinghouse Electric and Manufacturing Company has received the contract for a five-hundred light alternate current apparatus from Traverse City, Michigan. The electric light company at that place has been operating the Westinghouse alternate current incandescent system for some time, but the demand for incandescent lighting has grown so rapidly that this increase has become very necessary.

The Sedalia Electric Light Company, of Sedalia, Mo., which has been operating an alternating current electric light plant of the Westinghouse system for over a year, is about to enlarge its capacity. The company has just contracted for 750-light alternating current apparatus with the Westinghouse Electric and Manufacturing Company. This will give the plant a total capacity of fifteen hundred lights.

A few days ago the Lansing and North Lansing Railway line, of Lansing, Michigan, commenced operation, and, according to all accounts, everything went off with the greatest success. This is a street car company which has adopted the Westinghouse electric railway system and the officials of the road are very hearty in their praise of the system. A gentleman who was present at the starting of the cars stated that, although the motor men were all green hands, the cars ran without a hitch and in a manner perfectly successful. The opening of the line was quite an event in Lansing.

THE INTERIOR CONDUIT AND INSULATION CO.

This remarkably pushing and successful company had a slight set back last week on account of a fire that broke out at 527–537 West Thirty-Fourth street, at midnight, in the room where they dry green tubing. President E. H. Johnson writes us as follows: —"In reply to your inquiries I would state that the fire which partially destroyed our factory on Tuesday night, Aug. 26th, started in our drying rooms, and, after burning many thousand feet of green or untreated underground tube and effecting the destruction of our underground curing apparatus, was checked, so that the output of underground conduits will only be temporarily restricted. Having kept our original factory in West Twenty-seventh street on Interior Conduit work, this branch of our business will not be interrupted, and, with the aid of additional temporary factory facilities secured in that neighborhood, we will be enabled to aid the underground department materially. The burned building will be immediately rebuilt and a new structure seven stories high will be added. This will more than double our present accomodations and enable us to keep pace with the extraordinary demand made upon us."

We have ourselves had the opportunity of visiting the scene of the fire, and have secured one or two sections of cured tube that had gone through the ordeal. Where they were picked up, wood and iron and stone have disintegrated in a confused mass, but the tube itself, though in a measure carbonized by the intense heat, is whole and hard, showing a wonderful quality of resistance and endurance. The company were working night and day at Thirty-fourth street to fill their underground conduit orders, but, as will have been noted, will now enjoy larger facilities for production than ever.

THE WESTERN ELECTRIC CO.

The Western Electric Co. have just issued a very handsome new general catalogue. It is replete throughout with fine illustrations, and ample space has been allowed to display each cut and its accompanying descriptive matter. It is printed throughout in a clear, prominent type, on fine paper. The first portion of the book is devoted to their lines of annunciators, bells, push-buttons, electric gas lighting apparatus, batteries and material for work of this class, and some very handsome and efficient designs of these supplies are contained therein, as well as new specialties. The well known Paterson cables, which have met with such universal adoption everywhere, are then described, and some neat forms of cable hangers and terminals for a large number of conductors. Considerable space is allotted to a very full description of their arc and incandescent lighting systems, dynamos—both arc and incandescent—switch-boards, measuring instruments and kindred appliances for installation work being especially beautifully portrayed in very fine wood-cuts. Telegraph instruments, electrical testing instruments, speaking tube supplies, line wire, insulators and all kinds of tools and appliances for wire work, together with tables relative to size, weight and other properties of wires, complete a book which contains quite a

fund of valuable and useful information, and one which is of the greatest use to intending purchasers. Every one interested in electrical matters should supply himself with a copy.

JAS. W. QUEEN & CO. AS ELECTRICAL INSTRUMENT BUILDERS.

ONE of the interesting facts brought out by the recent Convention at Cape May came somewhat in the nature of a surprise to most of the delegates and visitors. It was that the old house of Jas. W. Queen & Co. had, with a remarkable display of energy and activity, stepped boldly to the front as makers of American electrical instruments, and were trying to build up their business on a scientific basis, showing in each production the benefit of thorough skill and knowledge. Up to about two years ago, the firm were handlers only of other people's goods. Seeing the advantage and necessity of having trained labor in this branch, they secured the services of two college men, to whom were specially entrusted the expert elements and details of the business, which soon became considerable, not only in electrical but in general apparatus. These men were Mr. R O. Heinrich, from Lehigh University, and Mr. E. G. Willyoung, from Michigan University. The former returned recently to Lehigh as Instructor in Electrical Engineering, but Mr. Willyoung spent a year traveling about among the laboratories of the country, and then came home to assume the duties of expert in chief. He now has a large corps of assistants and devotes the whole of his time to the superintendence of the designing and manufacturing and the general expert work of the house—which includes, of course, a large amount of electrical engineering. It may be mentioned that Mr. Willyoung, after graduating from Michigan University, occupied during 1887-8 the position of Assistant in Physics, and gave the instruction in the first year's work in Laboratory Electricity. During that time he was associated very closely with Prof. H. S. Carhart, the well known electrician, in all his expert work. This statement will help to give an idea of the expert ability brought to bear upon its products by the house, and it should be added that Prof. Anthony, president of the American Institute of Electrical Engineers, is still associated with the house as Consulting Electrician and in charge of standardizing and calibration.

As evidence of the departure made by Jas. W. Queen & Co., we would state that at Cape May Mr. Willyoung exhibited a complete line of their standard resistance boxes and portable testing sets. These were very much admired. The Standard Resistance Boxes included No. 1 set, designed and calibrated by Prof. Wm. A. Anthony and used as ultimate standard by the Electrical Supply Co., Edison Lamp Co., Moses G. Farmer, and all the leading electrical laboratories in the country. It is calibrated up to $\frac{1}{50}$ per cent. in accuracy.

The "No. 2 set," or improved Post Office pattern of Wheatstone's bridge standard megohm box, is in ten divisions of 100,000 ohms each, these divisions being capable of any combination of series or multiple as desired; terminals all at extremities of corrugated rubber pillars, so as to secure highest insulation. This was designed by Mr. Willyoung; also standard 100,000 ohm box in ten divisions, capable of any combination of series or multiple; standard 100,000 ohm box in four divisions not capable of use other than alone or in series. They expect to complete shortly the series by the production of a 10,000 ohm box subdivided into coils of 2000 ohms and less, and a 5000 ohm box subdivided in the same general way.

Their portable testing sets were five in number. The best one has a capacity of measuring from .001 ohm to 10 megohms, and is provided with a fibre-suspended galvanometer, which may be removed and used separately if desired. The needle of the galvanometer is thrown out of place by simply closing the lid of the box. A number of these have lately been sold to the government. The other four were of the same general style but of less capacity, and do not allow of the independent use of the galvanometer.

The first one of the above series of testing sets and galvanometers combined was designed conjointly by Mr. Heinrich and Mr. Willyoung; the others of the series by Mr. Willyoung alone. They are all calibrated by Prof. Anthony.

The firm also showed a complete line of capacity and contact keys, all of their own manufacture, and of the most approved design.

A large line of galvanometers, including those of Sir Wm. Thomson and other European inventors was also shown, including a number of ammeters and voltmeters, notably those of Ayrton & Perry, for whom they are sole agents; a curiosity among these was one ammeter up to 600 amperes; Schuckert ammeters and voltmeters, and those of Hartmann & Braun, for whom they are also agents; also Carpentier ammeters and voltmeters. Much interest was shown in the improved design of magnetic vane instrument, designed by E. G. Willyoung and just brought out by Queen & Co. The improvement consists chiefly in the placing of the moving system in a very close air damper, so as to render the instrument considerably more dead beat. These instruments are now, it is explained, the cheapest and best station instruments made, and are used entirely by the Mather Electric Co. and very largely by the Edison and Brush companies. They are now making several large instruments of this type up to 400 amperes for the Edison Co., to be placed on the Sound steamer, "Plymouth." They are made in all ranges and sizes.

A portable photometer designed by Mr. Willyoung was also shown, specially intended for street work and lighting inspectors. It measures from 7 up to 2,000 c. p., and the whole thing packs up in a compass of 37 inches by 5¼ inches, cross section.

Queen & Co. are now working on several new specialties which will be brought out in the fall. One of these is a large photometer for electrical laboratories exclusively. Another is a new ohmmeter giving direct readings of resistances up to 2,000 ohms, to within ½ per cent. accuracy.

McDOUGALL ELECTRIC CO.

The McDougall Electric Co., of the *Times* building, this city, have for the past month been running their car experimentally on the Seventh Avenue division of the Broadway road. The system was fully described in THE ELECTRICAL ENGINEER of July 23. The power is conveyed from the single motor to one axle through a double spur gear transmission, the other axle not being used for propulsion. The gears are encased in removable shells, which retain the lubricant and exclude grit. The current for the car is furnished by Gibson storage batteries. The quickness with which the car can be got under full headway from dead rest is very noteworthy. No effect is shown by the motor in the way of strain; and the operation of the car at all speeds is smooth and noiseless. The motor is intended to be used for all purposes, including not only storage traction but overhead wire operation, stationary motor work, etc. Mr. McDougall's practical experience enables him to meet the many conditions of difficulty in a very successful manner.

NEW YORK ELECTRICAL MANUFACTURING CO.

Mr. A. Noll reports that the business of the company is brisk. They have received an order from the Perfection Switch Co. to manufacture 50,000 porcelain base single pole switches. They are also doing a rushing business in their Barriett motors, especially the neat little "baby" size which has just been brought out.

THE VULCANIZED FIBRE CO.

We have received from the above company, of 14 Dey street, a copy of their catalogue and price list. It is a very interesting publication, showing the great number of uses to which the fibre has been applied, not only in electricity but in all the arts. For electrical purposes, the fibre is usually furnished in strips 8 inches wide by 40 inches long, which permits of its being more densely rolled. The tubes are from 20 to 22 inches long.

EUREKA TEMPERED COPPER.

We have noted from time to time the use of Eureka tempered copper on dynamos and motors and have looked upon its use as an evidence of good judgment on the part of their builders. We are now glad to note its use on the new direct current machine of the National Electric Manufacturing Co., of Eau Claire. The commutator of this machine is made of tempered copper, which is found to answer admirably for the purpose.

ALFRED F. MOORE.

The new catalogue just issued by Alfred F. Moore, of Philadelphia, is a beauty. It has a very handsome cover in gold, and several of the pages are printed in colors showing exactly how the wires and cords look. The catalogue is very complete, giving sizes, prices, etc., and entering into a variety of details. All classes of insulated wires are enumerated, as well as a variety of superior cables.

ARMINGTON & SIMS ENGINE CO.

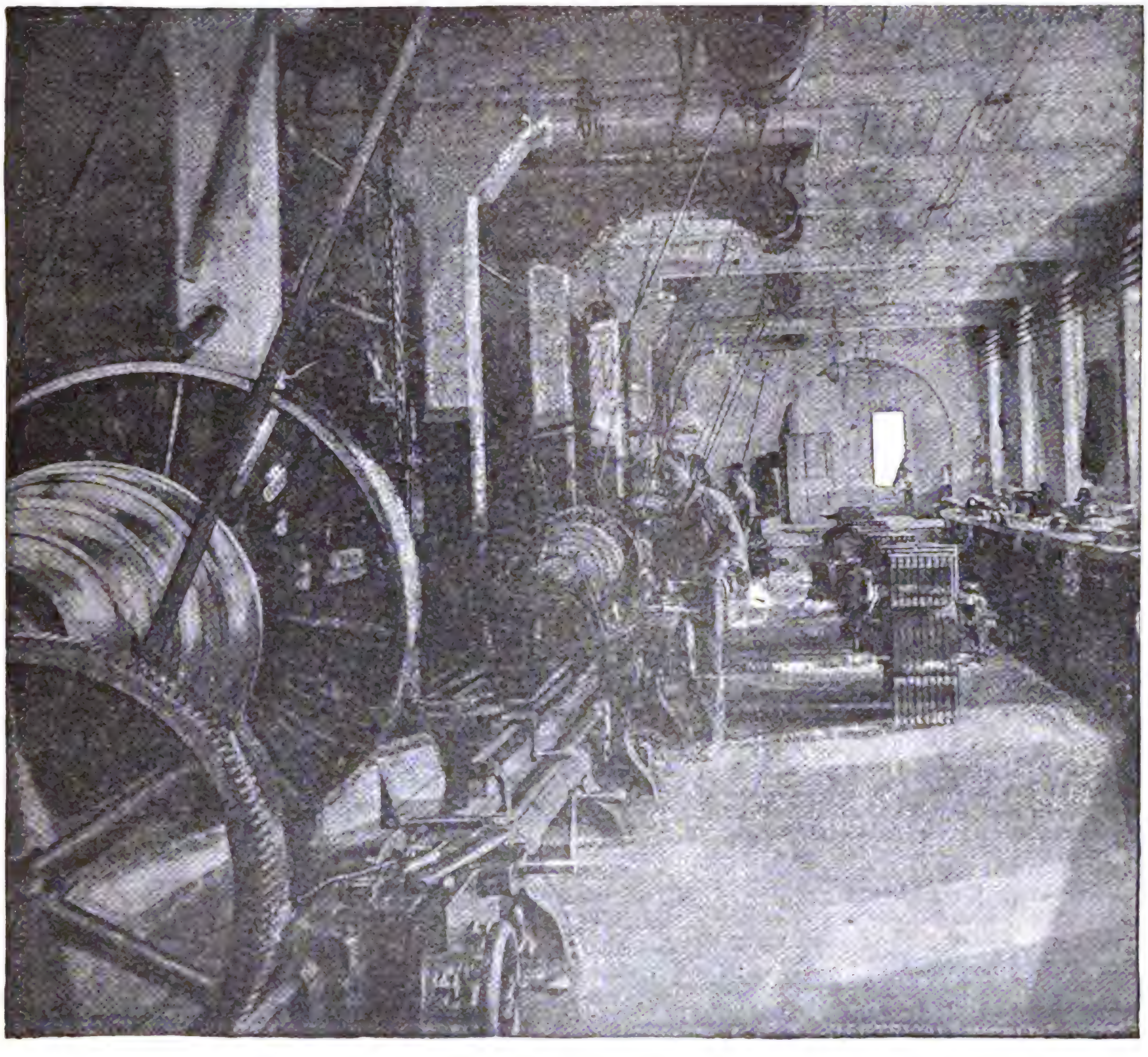
A handsome and well-deserved compliment has been paid by the people of Rhode Island to Mr. G. C. Sims in the proposition to run him as the Democratic candidate for Governor of the State. Writing on this subject, the Boston *Herald* says: "There comes the suggestion that the party could not find a better man to place at the head of its ticket this fall than Gardiner C. Sims. The suggestion is a good one. There could not be named a better, cleaner or more progressive man. He is of the people, a self-made man, a practical mechanic, who, by his own industry, his great inventive genius and his steady application to a task which he set himself to accomplish, built up a business in this city which is known the world over, although it is not much more than in its infancy. He is of the firm of the Armington & Sims Engine Co. He is the

general manager of the company, which has recently taken the Richmond print works on Eagle street and converted them into a busy hive of industry. He is also a popular member of the Commercial Club, where he has raised his voice against the best speakers that could be brought to this city, and always in the cause of enlarging the trading facilities of the country, and giving a market elsewhere for the products of the American mills and manufacturing establishments. Such a man as he could not fail to command the entire vote of his party and the respect of the Republicans, and he might be the means of bringing to the party a healthy support from the Independents. Where opposition could come from would be a mystery, excepting that some might raise the cry that he is a gentleman." It is understood, however, that Mr. Sims will find himself unable for the present to give up any time to politics and public office.

THE UNITED ELECTRIC TRACTION CO.'S. FACTORY AT MARION, N. J.

The above company have, in their establishment at Marion, N. J., one of the largest electrical factories in the country. It covers a considerable area, and is devoted exclusively to the production of motors and of electric railway apparatus. The view which we show of it herewith is taken in the aisle of the assembling shop of the factory. The motor frames shown in the right middle ground are standard 30 h. p. motors of the traction type. It is noteworthy that this is the only shop or room in the whole factory operated directly from the engine. All the rest are driven by motor.

The United Electric Traction Co. are not only busy on general power and electric railway work, but are occupied with storage car installations. They have just sold a consignment of storage cars complete to the Citizens' Street Railway, of Indianapolis, for cash on receipt of the bill of lading. This is claimed to be the first time a sale of storage cars has ever been made, and certainly shows that the storage car "has arrived." Other installations of the same kind are being prepared.



View in Assembling Shop of the United Electric Traction Company's Factory.

NEW YORK SUBWAY WORK.

The board of electrical control met on August 22 in the mayor's office and received a report from the construction company, which shows the work of burying the wires is going on satisfactorily. The report shows that in 1889 56,035 feet of subway and 621,430 feet of ducts were laid. This year, so far, 158,181 feet of trench have been dug and 774,926 feet of ducts laid.

The Edison company made application to have subways built in a number of streets. The application was laid over. The most important subway line asked for is in Fifth avenue, from Washington Place to Fifty-ninth street.

The subway company was instructed immediately to build a subway for Third avenue through Eighty-fourth, Eighty-fifth and Eighty-sixth streets, so that wires can be extended to the East River park, which has been ordered to be lighted by electricity.

Ex-Judge Kelly, of the East River company, complained that in Twenty-third street, between Fourth avenue and Broadway to University Place, all the ducts were used up, and his company could get no accommodations. He complained that it practically shut off his company from making connections with its main lines. The subway company was ordered to provide space for the company at once.

In Twenty-third street, from Fifth to Eleventh avenue, in Forty-second street and in Seventh avenue the Brush and United States companies have lines of poles standing which are used for city lights. There are subways in these streets, and inquiry was made why the subways were not used. The companies' representatives explained that previous to the contracts awarded, a few days ago, the companies had no business in these streets, and, consequently, had not used the subways. The companies said that now that they had business in the streets the subways would be used.

The mayor said that the companies must get their overhead lines down in four weeks or he would order them cut down.

The question whether the Fire Department should have a separate duct in the subways for its wires, instead of going into

the same duct with the police wires, was only touched on in a general way. Mayor Grant had the correspondence that had passed between himself and the Fire Commissioners on the subject before him, and remarked: "I must say that the Fire Department is not facilitating the work of the board as it should."

The mayor intimated that the attitude of the Fire Board in this matter was wholly unsatisfactory to him. Henry D. Purroy is president of the Fire Board. There is a rumor that Purroy and Grant are drifting further apart than ever.

PATTISON BROTHERS.

The above electrical engineering firm of 135–137 Broadway have just finished putting to rights the lines and station of the Edison Electric Illuminating Co., of Lancaster, Pa. They have also just completed the wiring for 250 incandescent lights in John Simmons & Co.'s factory in Leonard street. They are also installing a 45-light arc plant in Sunbury, Pa., for Mr. P. B. Shaw.

THE PERKINS ELECTRIC LAMP COMPANY.

The above concern, manufacturers of the Perkins incandescent lamps and sockets, have removed their executive offices from Hartford to the factory at Manchester, Conn. Mr. M. S. Chapman is president of the company; Mr. W. G. Halm, vice-president; C. T. Welles, treasurer, and J. J. Gates, secretary and general manager.

THE EDISON-LALANDE BATTERY.

The Edison Manufacturing Co., represented by James F. Kelly, general sales agent, 19 Dey street, this city, have issued a very striking and pretty circular in colors showing the battery and its details, and giving a very neat fac simile reproduction from THE ELECTRICAL ENGINEER of July 30, of the item in regard to the extensive use made by the Western Union Co. since, and owing to, the great fire in its operating department at 195 Broadway.

NEW ENGLAND TRADE NOTES.

THE AMERICAN WALTHAM WATCH CO. has declared a semi-annual dividend of 4 per cent., payable Sept. 1.

MR. H. M. UNDERWOOD, general agent of the Interior Conduit and Insulation Company, was in Boston this week, and reports business to be something phenomenal. They are putting in new machinery at their factories all the time both for house and underground work, but have difficulty in keeping up with the demand for their goods.

THE REDDING ELECTRIC COMPANY are enjoying a great run of active business in all lines of electric supplies, and are having a brisk demand for their well known electric Watchman's Clock, the only clock which *prints* a plain record from each station. Among their most recent sales is a forty station clock for the new factory of the Woonsocket Rubber Company, making the third clock manufactured by the Redding Company which this company is using.

THE MASSACHUSETTS ELECTRICAL ENGINEERING CO. have made an undoubted success of their tested fuse wire. This wire is specially drawn for them, and carefully tested for exact carrying capacity, and a certificate accompanies each spool. They have recently had an unprecedented call for this wire, and the demand is keeping their testing department quite busy getting large quantities ready for shipment. They are filling well a long felt want in supplying a fuse wire which is absolutely reliable.

HAZLETON TRIPOD BOILER CO., of Chicago, has opened a branch for the New England States at 620 Atlantic Avenue, Boston, and Mr. William Phenix will be general agent. Mr. Phenix has had a large experience with the Hazleton tripod boilers, and he reports a rapid and growing demand for them all over the States. They are specially well adapted for electric light and power stations, taking up but little room, and requiring very little care, b sides being extremely economical and free from danger. All contractors in the East should take an early opportunity of visiting Mr. Phenix's office, where they will receive every courtesy, and be afforded an opportunity of investigating the merits of this type of boiler.

WARREN S. HILL, of Boston, is making quite a success of his patent double pole converter switch, which he designed recently for alternate current work. These switches are enclosed in small iron boxes, and should be used wherever a converter is used, as they make it perfectly safe for workmen to handle the converter or do any repairs on the secondary wires. The boxes are made thoroughly waterproof and can be fixed outside on the same pole with the converter, all that is outside the box being the handle to operate the switch. Mr. Hill has furnished several stations with a complete set, one box for each converter in use, and experience has shown that the extra expense in using them is quite insignificant compared with the extra immunity from danger in handling alternating current wires. Mr. Hill also is making large numbers of his ordinary single and double pole switches on slate bases, which are meeting with general approval everywhere.

THE ECONOMIC ELECTRIC CONSTRUCTION CO., of Boston, have now got their new factory at Brockton into proper running order, and are beginning to turn out dynamos and incandescent lamps. The factory is well adapted for the purpose, being clean, light and roomy, and they have a skillful set of men at work. In the lamp department they have at present a capacity of about 1,000 incandescent lamps a week, and they are constantly adding new machines to increase the capacity. The lamps are made of all voltages and candle-powers, and to suit any socket, and besides their own filament they use also the Siemens-Halske, for which they have the exclusive agency in the United States. The Economic Co. have perfected the type of dynamo, called the Hooper dynamo, which they will put on the market soon, and most satisfactory tests have been made with it. The dynamo is of the four-pole type, is well designed and looks extremely graceful, besides giving a very high efficiency. It is simple, easily constructed and considerably lighter than the ordinary machines of equal capacity of other manufacture.

WESTERN TRADE NOTES.

MR. G. A. EDWARD KOHLER, the Western representative of the Eddy Electric Motor Company, has sold Rand, McNally & Co. one of their large plating machines.

MR. W. H. HARDING, manager of the South Side Electric Company, is back in the city and is rapidly pushing his new station to completion. He expects to start up in a day or two.

MR. ERNEST L. CLARK, secretary of the Illinois Electric Material Co., has been in Quincy, Ill., for the past week, on business connected with the electric street railway there.

THE POND ENGINEERING CO. are installing the large steam power plant for the Calumet Electric Railway Company at South Chicago.

MR. FOREE BAIN has just completed some highly satisfactory tests of his new 100 horse power generator. This machine only absorbs ¾ of 1 per cent. of the output for the magnetization of the field, which is a highly desirable feature.

MR. POND, of the Pond Engineering Company, has been in town for the past few days. He has been kept busy with Mr. Albert Blanchard, his Chicago representative, in looking after the large business which has been worked up here and in the vicinity by that able gentleman, who is well known among the fraternity as a hustler.

MR. W. S. ARMOUR, the Chicago agent of the Detroit Motor Company, 320 The Rookery, has just placed a 7½ horse-power motor on the Edison circuit. This motor will operate the printing establishment of R. R. McCabe & Company, 334 Dearborn street, in the new Caxton building.

THE WESTERN POWER CONSTRUCTION CO. are doing lots of business, and the factory at Auburn, where the well-known McIntosh-Seymour engines which they handle are manufactured, is pushed to the utmost to fill their numerous orders. Mr. Waldo P. Adams, the general manager of the Western Power Construction Co., is in town again, back from a trip to the East in which he was highly successful in securing business.

THE SPERRY ELECTRIC CO. are receiving inquiries from all over the country regarding their new triple carbon lamp, which is creating quite a sensation. Their lightning arresters have shown some remarkable proofs of their reliability and efficiency, one of them in taking care of no less than 15 strokes in two hours during a recent storm without a cent of damage. They are now putting an improved form of this arrester on the market.

THE ILLINOIS ELECTRIC MATERIAL CO. are meeting with great success with their new woven insulated line wire. Mr. "Canvas-Jacket" Hoefer, the general manager of the company, reports the demand for this wire as unprecedented. He is now known by the above appropriate title amongst his electrical friends in town, who keep continually asking him "What is Canvas-Jacket?" Mr. H. S. Winston, the president of the company, has returned from the convention at Cape May, well pleased with the results of his Eastern trip.

THE PUMPELLY STORAGE BATTERY AND ELECTRIC MOTOR CO., 129 La Salle street, Chicago, have shipped 37 cells of battery to J. H. Munson & Company, at Evanston, Ill., where they will be employed by Mr. Munson, who till recently has been the electrical expert of the university there, for lighting the incandescent lamps which will decorate his four-horse wagon in which he will attend the business men's picnic there. In this he has introduced some striking novelties in lighting effects obtained by the revolution of the wheels cutting lights in and out. He will also use the current to operate some small motors.

THE

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[INCORPORATED.]

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T. COMMERFORD MARTIN AND JOSEPH WETZLER.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.

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EDITORIAL ANNOUNCEMENTS

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers*

VOL. X. NEW YORK, SEPTEMBER 10, 1890. No. 123

This, the greatest by far of all the marvels of the electric telegraph.—Sir W. Thomson.

NEW YORK'S TELEPHONE SERVICE.

CLOSE to the telephone now in use in the printing office of THE ELECTRICAL ENGINEER is nailed a dingy old yellow card, in which the instructions given to the subscriber read: "To Call Central Office: Press the button three times, take the telephone from the hook and place to your ear, and listen for a response. * * * When through talking, hang up the telephone, and then press the button three times." Such was the crude and archaic method of signaling "central" a few years ago, and the distance traveled, as well as the enormous improvements made, since that old card was put up, can only be realized by reading the excellent article contributed to our pages this week by Mr. Herbert Laws Webb on the telephone service of New York to-day. It is safe to say that able, intelligent and progressive as were the men who directed affairs in the early telephonic days in this city, they had not the remotest idea of the shape that the service and apparatus would take under the pressure of new conditions, and thanks to the efforts of inventive genius or trained experience.

It has been the fashion, and a sorry one, to find fault with the telephonic management in our leading cities as at once parsimonious and incompetent; but no one can read Mr. Webb's account of what has been done, and is still to be done, without feeling how great is the thought and care that is directed to the perfection of the work. The problems that come up for solution are among the most complex and abstruse that offer themselves to the modern electrical engineer, and while no one believes that the goal has been reached, it would show little appreciation of zeal, skill and energy not to praise such achievements as this article brings before us. Not even a hundred articles of equal length could tell of all the labor and experiment, to say nothing of the capital required to attain these definite, practical results that constitute the basis of the methods employed to-day.

An instance of the manner in which the telephone manager and engineer have had to grapple with new conditions is presented in Mr. Webb's description of the underground system. A very few years ago the wires were all overhead, and we have in our possession an old cartoon from one of the comic papers in which the telephone service is represented by a big spider at the centre of a huge cobweb of wires. To-day, in New York, as Mr. Webb shows, there are in operation from the different exchanges nearly 300 separate underground cables, each containing 50 twisted pairs of conductors, aggregating 145 miles of cables or 14,553 miles of wire. The next cartoon will evidently have to depict a hydra with heads or tails out of a hundred cavernous lairs. These cables represent, of course, an immense investment, and their maintenance and testing has become one of the most important branches of the work.

Altogether, we think the Metropolitan Telephone Co. has evinced in a praiseworthy manner a desire to meet all the needs of the hour; and the articles appearing also in this issue as to work in Philadelphia and Hartford indicate the same spirit of progress and improvement. It is in this way that preparation is rightly made for the future, and the business held, not simply because the service is the only one, but because it is the best.

DANCING TO MUSIC FROM AFAR OFF.

ON Thursday night last an interesting and really notable musical and vocal entertainment was given from New York to a very large audience assembled at the Grand Union Hotel, Saratoga.

As our readers will conjecture, the audience, which numbered at times no less that 800 people, was brought *en rapport* with the performers by means of a "Long Distance" telephone circuit running a distance of 180 miles from 18 Cortlandt street, New York, to Saratoga. From Cortlandt street a circuit had been run to the Madison Square Garden and the concert being given by the Strauss Orchestra was taken in alternation with the other numbers of the programme which comprised selections by the Long Distance orchestra, flute and cornet solos, a whistling song and glees by members of the technical staff, one of whom also recited Tennyson's "Charge of the Light Brigade." The orchestral music was listened to at Saratoga by means of sets of hand telephones, and every note was heard distinctly, even to the applause of the audience gathered at Madison Square. Some of the songs and solos and the recitation were heard all over the room at Saratoga by means of a single loud speaking receiver provided with a large funnel-shaped resonator to magnify the sound. Great delight was expressed by the audience at Saratoga with the evening's entertainment, and the exhibition was considered one of the best and most successful that has yet been given over the Long Distance Company's system.

A very novel and striking use was made of this tele-

phonic concert by Mr. A. S. Hibbard, who happened to be entertaining a number of his friends at his residence in Morristown, N. J. the same evening. Mr. Hibbard's private telephone line was connected at Cortlandt street with the circuit running to Madison Square Garden and the strains of the famous orchestra were heard so plainly in the house at Morristown that dancing was carried on with perfect ease and comfort by the guests there assembled.

If some one had told Herr Strauss that his orchestra was playing for dancers who were enjoying themselves at Morristown, some twenty or thirty miles distant, the information would probably have been received with sheer incredulity, yet such was actually the case. Two Strauss waltzes were enjoyed by Mr. Hibbard's guests and afterwards the orchestra at Cortlandt street was switched in and dancing was continued by the music of the less ambitious band of performers.

We believe this is the first instance recorded of the transmission of music by telephone with sufficient volume and clearness for dancing to be indulged in by the listeners.

MULTIPLE SWITCH-BOARDS.

Though to an outsider who rarely enters an exchange telephony may appear to have become stationary so far as improvements in the art are concerned, much in reality has been accomplished during the last few years, and the results of this work are already beginning to make themselves felt. A single improvement alone, that of the multiple switch-board, over the single boards with their intermediate connections, has done much to simplify the work within the exchange, but the enormous increase in the number of subscribers connected to one exchange has made even the multiple board unwieldy to some extent in our largest exchanges. As a result, steps are already being taken to increase the capacity of the central office operator by differentiating subscribers into groups and giving the calling subscriber the power to call up either group by a simple manipulation. This has been very well carried out in the multiple switch-board designed by Mr. M. G. Kellogg and described on another page. The saving in the cost of the office equipment brought about by means of this system will at once be obvious, and the means by which this has been carried out are exceedingly simple and ingenious. The employment of the telephone magneto to send currents of either polarity to line is a decidedly novel application and might possibly be used in certain forms of telegraph work.

LOCKWOOD'S TELEPHONE SYSTEM.

The great success which has attended the employment of closed circuit transformers in electric lighting by the alternating current would naturally suggest the employment of this type of transformer or induction coil in telephony, and indeed such a transformer was proposed some time ago, but its employment directly, in place of the open circuit transformer, was accompanied by difficulties, principal among which was the fact that the nature of the current in the primary circuit was not of an alternating character, but was one involving simply a change in strength without a change of polarity. The reasons which prevented the direct employment of the closed circuit transformer for telephonic work are, therefore, practically the same as those which have made it unsuitable for employment as an induction coil where it is intended to produce a disruptive or spark discharge. In seeking, nevertheless, to employ the closed circuit type of transformer in a telephonic circuit, and thus to throw effective alternating currents upon the line, Mr. T. D. Lockwood has hit upon the ingenious idea of combining the open circuit with the closed in the manner described elsewhere in this issue. The method is one which might possibly be employed in other branches to obtain a true alternating current from a pulsating continuous current.

Tesla Alternating Current Motors.

In a recent issue we described at length some new forms of alternating current motors designed by Mr. Nikola Tesla, and involving some novel methods for producing motion in contiguous circuits acted upon by alternating currents. In a short review of this article appearing in our excellent contemporary, *Industries*, a writer accuses Mr. Tesla of holding to the old fallacy of the screening action of the iron to explain the action of his machine. A careful study of our original article makes it apparent, however, that our contemporary has misunderstood the character of the machines described. It would take us too long to point out the error into which our contemporary has fallen, and to state in exact terms just what is accomplished by the construction adopted in Mr. Tesla's machine, but in answer to the closing remark of our contemporary, it is incumbent upon us to state that machines constructed on Mr. Tesla's principles are in actual commercial operation at the present time with no small measure of success.

The Unit "Henry."

Prof. F. B. Crocker has an interesting letter in this issue, in which, while expressing his pleasure at the support given by Dr. Fleming to the new units, he differs from that authority as to the advisability of abbreviating "henry" into "hen." In our remarks on Dr. Fleming's recent letter in these pages, we called attention to his suggestions as to "frank" and "gilb." On the whole, we think that while "frank" and "gilb" may pass muster, "hen" would hardly do so. There is an invitation to ribaldry and irreverent mirth about it, and no one would be surprised to hear a playful junior engineer, who meant to speak of "microhens" referring to them as so many "spring chickens." The Institute will have this matter of new units up during the month, when Prof. Crocker will deliver an address on the subject, and the discussion promises to be one of great interest.

Open Circuit Transformers.

Notwithstanding the almost universal employment of closed circuit transformers in alternating current work, Mr. James Swinburne has taken up and championed the cause of the open circuit type. While Mr. Swinburne admits that the efficiency of the closed circuit type of transformer is higher at full load than that of the open circuit, he claims for the latter a higher average all-day efficiency, and hence advocates its use. The details of construction given on another page will prove of interest to the reader, the omission of all iron or metal in the casing of the transformer being an interesting point.

ELECTRICAL ENGINEERS.

ALEXANDER GRAHAM BELL.

THE history of the practical development of the telephone and the telephonic art has been so often retold during the past 12 years in the litigations that have attended the establishment of commercial telephony, that its main facts are as well known as those connected with the invention of the telegraph. The literature of telephonic litigation constitutes, in fact, a library of astounding proportions, and it would seem as though there were little left to be said in that department of the subject. But, strangely enough, in spite of all this controversy of great lawyers and experts and the struggle for supremacy of embattled millions of capital, the career of Alexander Graham Bell, the inventor of the speaking telephone, has rarely been made a theme for gossip in the public prints. He has never cared to gratify natural curiosity, but, on the contrary, has generally held the paragrapher of the society journal and the interviewer of the daily paper at arm's length. This reserve is characteristic of the man, but we do not think that we disregard it in now giving his portrait to our readers with a few of the leading events of his life.

Alexander Graham Bell

Alexander Graham Bell was born at Edinburgh, Scotland, on March 3, 1847, of good old stock. His father and grandfather were both teachers of languages, etc., and his father, Alexander Melville Bell, who is still alive, has long enjoyed a reputation in the field of philology and linguistics, being the deviser of ingenious systems of "world speech" and "visible speech." He intended that his son should follow his profession and early gave him instruction in the anatomy of the vocal organs, their various functions and the different subjects belonging generally to the science of vocal physiology. When quite a child, A. G. Bell was told by his father of an automaton speaking machine he had seen, and the boy was so interested that he determined to attempt the construction of such an apparatus himself. In a word, he then and there invented a speaking machine, built it and made it articulate one or two simple words. While at Elgin, in Scotland, he found out for himself, also, that the elements of speech were compound in their nature, and became interested in the important work done by Helmholtz, relating to the quality of vocal sounds. In 1865, the family removed from Scotland to London; and about 1866, at Bath, in England, he conceived the idea of following up Helmholtz's synthetical experiments in the reproduction of sound, by attempting to transmit speech electrically. Between the years 1867 and 1870, he made numerous electrical inventions based on the Helmholtz vowel apparatus, and, before he left England, had resolved to pursue one of these inventions, that of harmonic or multiple telegraphy, to a practical outcome. The idea of actual speech transmission was running in his mind all this time, like an undercurrent of thought that he could hardly formulate in definite expression; but it gradually took clearer shape, and Mr. Bell has stated on the witness stand that to friends in England, before 1870, he avowed his belief that we should "one day speak by telegraph." He did not himself imagine for a moment that that great achievement was to be his, but if ever a man were fitted to produce such an invention, by heredity, education, surroundings and temperament it was surely he.

In August, 1870, the Bell family emigrated from England, to Brantford, Canada, and in April, 1871, A. G. Bell went thence to Boston, on the invitation of the Boston School Board, to carry on a series of experiments with his father's system of "Visible Speech," or physiological symbols for the deaf. He remained permanently in the neighborhood of Boston, from October 1, 1872, until his removal to Washington, in 1881. From the very moment of his arrival in Canada, in 1870, up to the beginning of 1874, his mind was full of the scheme for the multiple transmission of telegraphic messages by means of musical tones, and he had other telegraphic inventions also in hand; but the old idea of speech transmission was persistent in claiming his attention, and gradually his thoughts and energies were narrowed down to this one field of investigation. He has himself narrated more than once the manner in which he proceeded, stage by stage, from his experiments with phonautographic apparatus, human ear drums and apparatus for obtaining undulatory currents, up to the period when he and his assistant, Mr. T. A. Watson, were able to talk to each other telephonically over a short line in the Boston University, and when by rapid strides the crude apparatus was improved and brought up to a fair degree of efficiency. The first tests with the telephone as a speech transmitter were watched with great interest by many scientific men to whom Bell communicated his results freely and from whom he received many valuable suggestions; but the press and public were sceptical in regard to the reports that began to circulate. Bell's first public lecture on the telephone was delivered before the Society of Arts, Boston, May 25, 1876; but the first time that speech was transmitted over a real line was August, 1876, at Brantford. He hastened to patent his invention, and the same year exhibited it at the Philadelphia Centennial Exposition, where a memorable display of its speaking powers was made on Sunday, June 25, 1876, before Sir William Thomson, the Emperor of Brazil, Prof. Sterry Hunt, Dr. Draper, Dr. Koenig and others.

The vicissitudes of the Bell telephone from that time are a familiar and hackneyed story, both as to its commercial development and the various infringement suits brought successfully by the American Bell Telephone Co. against

a number of persons, the most prominent of whom were Meucci, Dolbear, Drawbaugh, Clay and Cushman. The litigation between the Western Union Telegraph Company and the Bell Telephone companies resulted in a compromise, by which the priority of Bell was recognized, and the former company granted the latter an exclusive license under its Page, Edison, Phelps, Gray and other patents held to be controlling in various respects. The long warfare in the courts may be said to have reached its conclusion, when the Supreme Court of the United States sustained Bell, for nothing is ever expected to come of the absurd suit brought against Bell, in the name of the Government, for fraud in obtaining his patent.

In the fall of 1877 Prof. Bell married Mabel, the daughter of Hon. Mr. Gardiner G. Hubbard, to whom he had been indebted for financial aid in developing his inventions; and who, with others, has since reaped a rich reward for courage and foresight. It was through his position as instructor to Miss Hubbard, a deaf mute, that Prof. Bell became acquainted with Mr. Hubbard.

From first to last Prof. Bell has taken out twenty-one United States patents, as sole or joint inventor, the most important being, of course, the one on which is based the speaking telephone of to-day. The photophone, however, upon which he has worked, stands high also as a scientific achievement. Being decreed the French Volta prize, he devoted the money to the establishment, in Washington, of the Volta Laboratory, with a view to original investigation in the transmission and reproduction of articulate sounds; and the Association, as it was called, formed at that place included Mr. Chichester A. Bell and Mr. Sumner Tainter. Several inventions have been the result of the labors of the Association, principally the jet telephone and the graphophone. Prof. Bell has also, to some extent, given attention to devising improved methods of electrical communication between vessels at sea. Of late years, however, Prof. Bell has mainly devoted himself to his original pursuit, namely the study of the deaf and dumb, in connection with his father's visible speech; and he has given much thought, with no small measure of success, to the amelioration of the condition of such unfortunates.

Immediately after the invention of the telephone and its going into commercial use, Prof. Bell was called upon for papers and lectures, and for a time he yielded gracefully to the demand. Among the most noteworthy of his productions are: "Researches in Electric Telephony," a paper read before the English Society of Telegraph Engineers, London, October 31, 1877; "The Production and Reproduction of Sound by Light," a paper read before the American Association for the Advancement of Science, August 27, 1880, relating to discoveries made by himself and Mr. Sumner Tainter in the art of "Radiophony"; and "The Production of Sound by Radiant Energy," a paper read before the National Academy of Sciences, April 21, 1881, relating to further investigations of the same nature.

ELECTRIC RAILWAY TESTS IN BOSTON.

The West End Street Railway Company are making an extensive trial this week of different forms of truck, for the purpose of satisfying themselves which is the most economical in consumption of electrical energy in all conditions. The Ffinsk truck, the Tripp truck, and the Robinson Radial truck, are among those being tried, and they are all loaded down with sacks of meal weighing an equivalent of 100 passengers at 140 pounds each. The cars are being run back and forth between Grove Hall and Forrest Hills, and will run continuously all day, ampere readings, volt readings, and Edison metre readings being carefully taken, as well as a careful record of the speed by a tachometer. There are now in Boston nearly 300 electric cars in daily service, and the load is getting to be fairly constant, the ammeters in the power station showing but little fluctuation. The heavy granite foundation work at the central power station is about completed and the brick work is in rapid progress, and preparations are being made for work on the girder roof. The new Cambridge power-house is also making rapid progress.

THE NEW YORK TELEPHONE SERVICE.

BY HERBERT LAWS WEBB.

There are comparatively few people who appreciate the vastness of the telephone system in a great city like New York, and still fewer that have the opportunity of seeing from the inside the enormous difficulties to be overcome by telephone engineers in order that the service may reach that point of efficiency which they are always striving for and which impatient subscribers declare—in language more forcible than polite—to be unattainable. There are carping critics, generally newspaper scribes in want of a better subject upon which to expend their power of invective, or individuals belonging to that class of present day offenders against our peace and happiness who *will* write letters to their favorite daily organs on matters about which they are profoundly ignorant, who maintain from time to time that the telephone companies persist in rubbing along with antiquated apparatus, rusty and badly constructed lines and a general state of cheap disorganization, so that, secure from competition as they are, they may continue to extract from the poor down-trodden subscriber, the maximum *quid* in the way of rates in return for the minimum *quo* in the shape of service. That such a state of affairs does not exist, and, in the more important companies, never has existed, goes without saying, but even many of our readers who keep themselves well informed on telephone matters will learn with surprise of the high pitch to which the methods, and what may be termed the technical policy, of the Metropolitan Telephone and Telegraph Company have been brought, and how wide a difference exists between the actual state of matters telephonic in New York, and the lugubrious descriptions of them doled out to readers of the daily press. During the past few years the enormous plant of the Metropolitan Company has undergone, and, in fact, is still undergoing, a gradual and complete reorganization, and it is not too much to say that in the system of equipment for the new buildings now elaborated, the very acme of perfection in modern telephone working has been reached.

Beginning with the Cortlandt street exchange, situated at No. 18 Cortlandt street, familiarly known as "Telephone Headquarters," we find a Western Electric multiple switch-board with capacity for 6,000 metallic circuit subscribers; this board occupies the entire floor of the eighth story of the building, and has assimilated the subscribers formerly connected to the old exchanges at John, Pearl, Nassau and New streets. The engraving, Fig. 1, shows one side of this board. Quite recently another of the old down-town exchanges, that at Murray street, has been abandoned and its subscribers transferred to Cortlandt street and to the present exchange at Spring street and Broadway. This exchange, again, will shortly be installed, with an entirely new plant, in a model telephone building erected by the Metropolitan Company at the corner of Spring and Wooster streets.

The Cortlandt street board, which is the largest multiple switch-board in the world, has been in operation for about two years, and is now operating more than 3,800 subscribers, many of them equipped with metallic circuit lines. The average daily number of connections between subscribers made on this board is 48,236 and the average for the whole city is 103,621, about 93 per cent. of these connections being made between the hours of 8 A. M. and 6 P. M. At present there are 128 operators at Cortlandt street, each one of whom attends to between four and five hundred subscribers' calls per day of ten hours. The switch-board has given excellent service since first put into use and a few minor changes shortly to be made in its equipment will still further increase its efficiency.

The most interesting part of the Cortlandt street building for many readers of The Electrical Engineer is where comparatively few visitors penetrate; below the ground floor is a department known as the "underground room," where the cables which find a deviating and tortuous path through

New York's much abused subways terminate and make connection with the switchboard eight floors above. The room in its present state is not calculated to impress the technical man very favorably. As originally planned, the cable terminals were to be connected to the switchboard through a distributing board which lines the walls of the operating room at the rear of the switchboard. This distributing board consists of a series of vertical wooden racks placed at convenient distances apart to facilitate the handling of wires; above the racks are arranged the lightning arresters and resistance coils. The underground cables are extended from the cellar by flexible rubber covered cables running in ducts the height of the building and connected to one side of the lightning arresters and resistance coils. The distribution is then effected by running wires through the racks from the lightning arresters to the part of the switchboard required, the connection to the wiring of the board itself being reached by running the wires through troughs under the floor and up at the back of the board.

The underground system, however, has grown at such an extraordinarily rapid rate, that this method of effecting the "cross-connecting," a very important part of the daily work of a large telephone exchange, has outgrown its usefulness, so much so, that much of the cross connecting work necessitated by cutting new underground cables into service, changes in subscribers' addresses, etc., has had to be done in the underground room.

The problem of reducing cross-connecting to a systematic process devoid of all risk of confusion or literal "cross-connections" involving trouble and annoyance to all parties concerned, has lately been attacked in earnest, and the investigations conducted by telephone engineers has led to the invention and development of the Hibbard distributing board, which is illustrated in perspective view in the accompanying engraving, Fig. 2, which represents the one to be placed in the underground room at the Cortlandt street exchange. Mr. Hibbard has solved in a very simple manner the difficulties of "cross-connecting," and his distributing board is already in operation in several of the principal exchanges in the country, such as, for instance, those at Philadelphia, Boston, Baltimore, Albany, etc.

The engraving gives a general idea of the board. In telephone work the word "board" has got to be quite a conventional term, and in this case it stands for a framework built up of iron gas pipe and rods, of long and narrow dimensions, the vertical parts of the frame serving for supporting the hard rubber bases to which the connecting devices are attached, and the cross bars forming supports for the cross connecting wires which run through the frame-work from side to side. It is plain that if at each side of the frame-work we have a number of hard rubber strips provided with small metal plates to which wires are permanently connected, it will be a perfectly simple matter to connect any two wires terminating at one side of the board to any two terminating at the other by merely running a

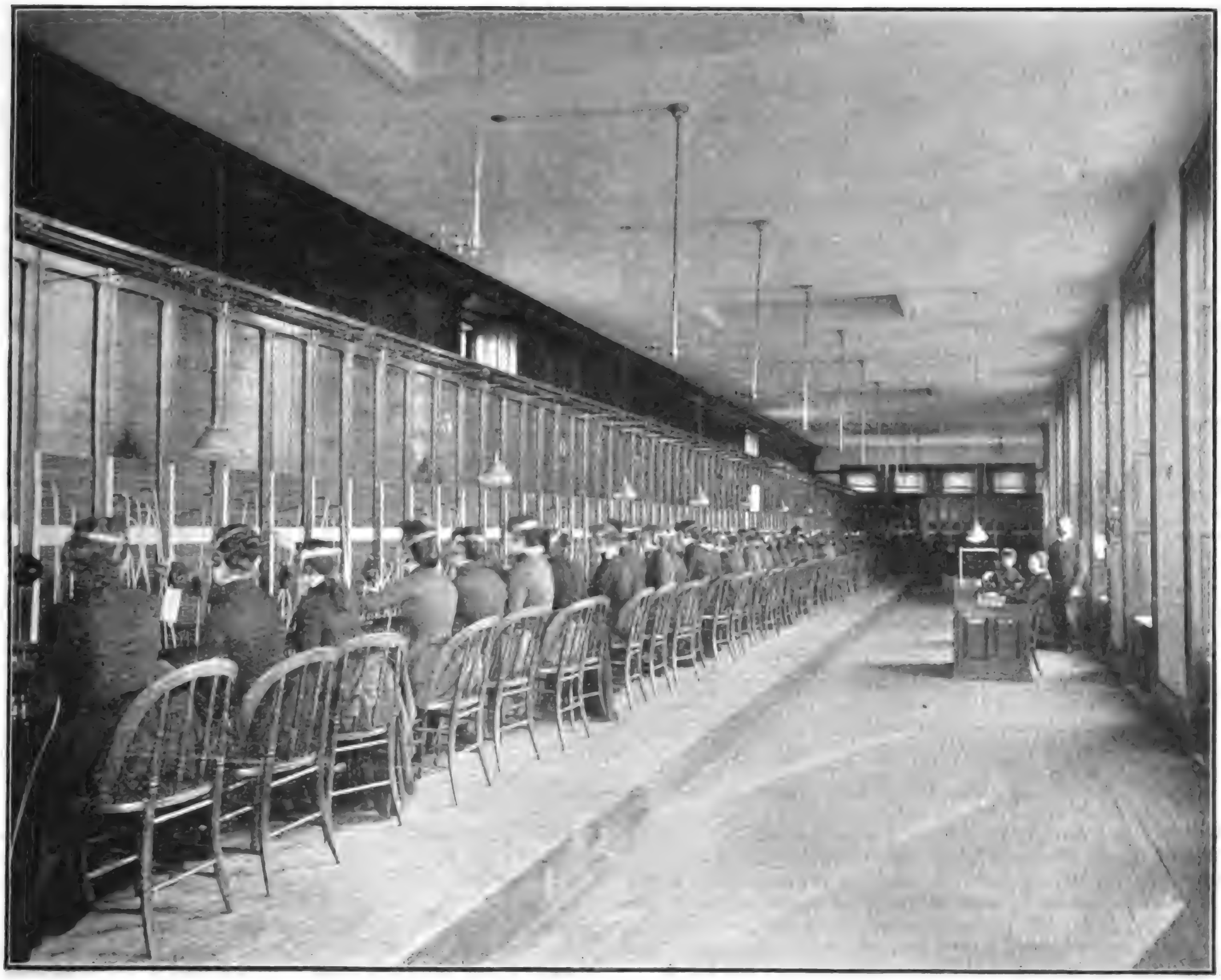


FIG. 1.—ONE SIDE OF THE NEW MULTIPLE SWITCHBOARD AT THE CORTLANDT STREET EXCHANGE, NEW YORK.

pair of wires through the racks in the middle of the frame-work.

The arrangement of the underground room at Cortlandt street when the new distributing board is in place will be as follows: Above the iron cable heads which form the terminals of the underground cables will be placed hard rubber strips provided with the proper number of Hibbard lightning arresters for each cable, and the cables will all be wired permanently to these arresters, all connections being soldered. From the arresters to the connection strips on the distributing board short cables will be run, thus extending the underground cables direct to one side of the distributing board, the only intervening piece of apparatus being the lightning arresters; as a break can be made in the line at this point by the removal of the fusible coil it is an easy matter to test any line in either direction when hunting for "trouble" on a subscriber's wire. In the same way cables will be run from the switchboard to the strips at the other side of the distributing board; these cables will be soldered direct to the switchboard terminals in the operating room, and also to the metal ears on the hard rubber strips of the distributing board, the wires belonging to the different drops being arranged in proper order, drop number one being the first connection on the first strip.

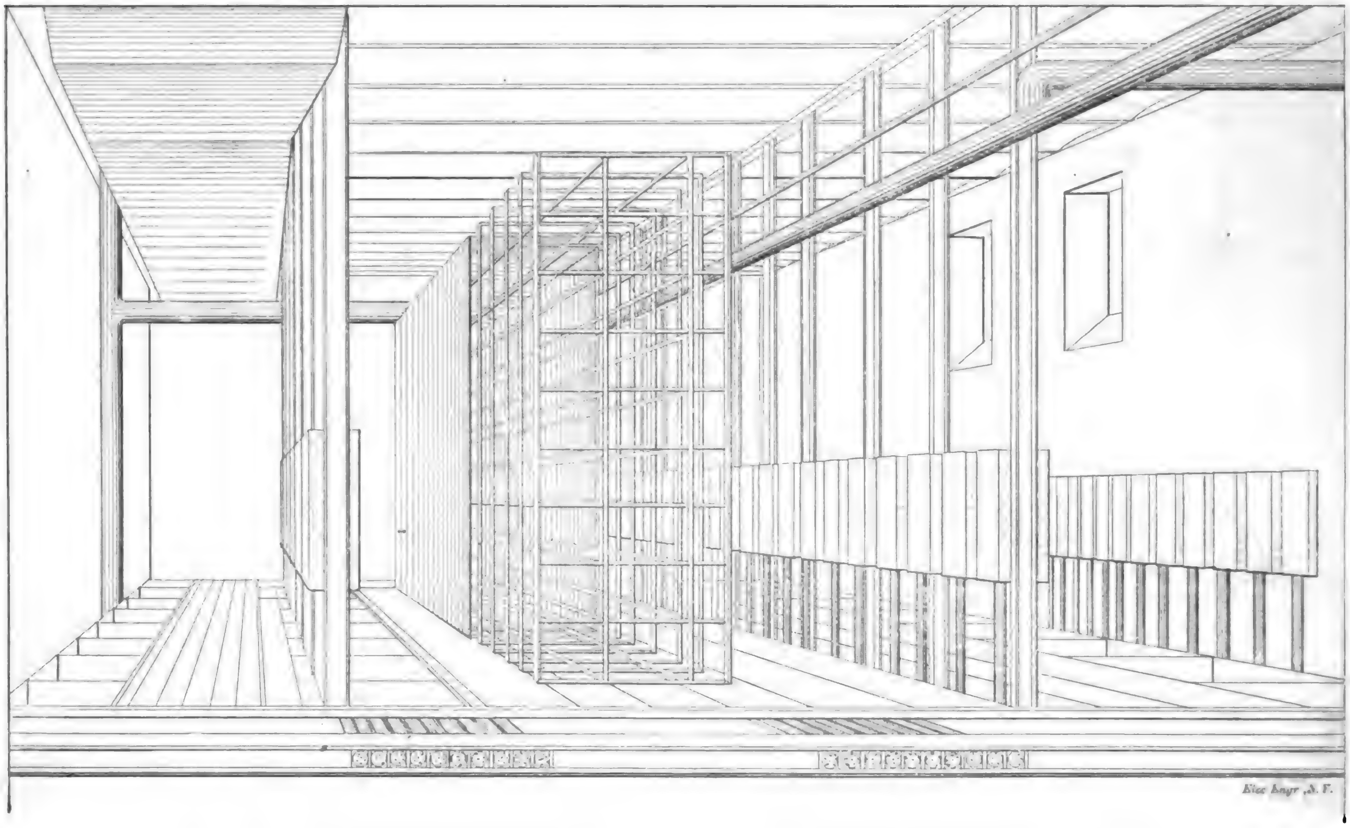


FIG. 2.—THE HIBBARD DISTRIBUTING BOARD AT THE CORTLANDT STREET EXCHANGE, NEW YORK.

This arrangement practically means the transfer of the switchboard terminals to the terminals on one side of the distributing board. We now have the terminals of the underground cables and those of the switchboard brought face to face, or rather back to back, separated merely by the iron framework, and in order to connect any desired pair of wires in any underground cable to a drop in any part of the switchboard, the only operation necessary is to run a pair of wires through the rack, making the requisite connections at each end. This will be the only cross connection between a subscriber's line and the drop required at any part of the exchange, and it will easily be recognized that this method of doing the work simplifies matters to a very great extent and renders it possible to make any number of changes between lines and their drops with the minimum expenditure of time and labor and the maximum amount of certainty.

The board designed for Cortlandt street will be 38ft. long, 7ft. high and 3ft. 1in. wide, and will have thirteen separate planes on which the cross-connecting wires will be run. All the cross-connecting wires will be rubber covered and twisted in pairs. The board has capacity for 154 underground cables, or, say, 7,700 pairs of wires. The cross-connecting wires will never be run diagonally through the framework, but when a connection has to be made between a point high up on one side of the board and another low down on the other the connecting wire will be run horizontally on the plane coinciding with its starting point and then up or down when opposite its destination in a vertical division of the framework at the rear of the board; in this way the openings at the front of the board will never be obstructed by the cross-connecting wires, the maximum number of which in any one plane will be about 600 pairs.

The work of putting in the distributing board is to be commenced very shortly, and from the description already given a faint idea may be formed of the magnitude of the task, involving the entire reorganization of all the connections between the underground cables and the switchboard and the making of some tens of thousands of new connections.

The underground plant of the Metropolitan Company has had a marvellously rapid growth since the inception of the underground wire regulations in New York. At present there are in actual operation from the different exchanges nearly 300 separate underground cables, each containing 50 twisted pairs of conductors, aggregating 145.5 miles of cable or 14,553 miles of wire. The Cortlandt street exchange, of course, has the greatest number of cables, as no less than 140 of the 300 terminate at this office. The cables vary greatly in length, as some are only a few hundred feet long running to buildings in or near Cortlandt street, where they terminate on roofs and are extended to subscribers' offices by overhead wires. There

are many cables over a mile in length, the longest being one of two terminating on a pole at Fifty-ninth street and Tenth avenue, which measures 29,069 feet, or nearly six miles.

The cables used are all made to conform to a set of specifications exacting certain electrical and mechanical requirements, and each cable is tested for insulation and conductor resistance and inductive capacity before it is accepted by the company and put into service. Full records are kept of all these tests so that the life of every cable can be watched from the time it is first laid down. At Cortlandt street a testing room has been fitted up containing a complete set of fine testing instruments, leads being run to the underground room where connection is made with the cable heads.

At Spring street, Eighteenth street, Thirty-eighth street and Seventy-ninth street nearly all the subscribers' lines enter the exchanges through underground cables, and the rapidity with which the underground work has been pushed has necessitated an equally rapid and radical change in the equipment of the company's central offices. The Cortlandt Street Exchange is a modern telephone building, but changes there, as we have seen, have become necessary long before the building has lost its modern air. With the other exchanges the company has adopted the very sweeping policy of entirely abandoning the old plant and removing the subscribers' wires to entirely new buildings erected by the company and equipped throughout as model telephone buildings, according to the most approved principles of telephone engineering, as that branch of the science is understood to-day.

One of these buildings has just been inaugurated at West 38th street, the lines formerly running to the old exchange, at 39th street and Sixth avenue, having all been transferred to the new office less than two weeks ago. A similar building has been erected at the corner of Spring and Wooster streets, and the transfer of the old Spring street exchange to the new will be made by the beginning of next year. Another telephone building is to be located on Franklin street, and still another at Broad street. These four new offices will have an aggregate capacity for operating 14,400 metallic circuit lines. Uptown, a new office will shortly be established at 79th street and Third avenue, and the Harlem exchange is being rehabilitated in order to arrange the apparatus for metallic circuit working; to place the Harlem exchange in connection with the underground system a subway is now being built in that direction, the route of which for a considerable distance passes through solid rock which has to be blasted out in order to provide a passage for the subway.

The equipment of the new telephone buildings will not differ materially from that of the Cortlandt street office, with the exception that all the vital parts of the offie will be on the same floor. Instead of terminating the underground cables in the cellar they will be run up a shaft to the top floor, where a "terminal room" will be provided for their reception. The Hibbard distributing board will be located in this room and the cross connecting will be done as already described. In the terminal room there will also be a chief inspector's desk provided with spring-jacks and connections, by means of which the chief inspector can plug on to any faulty line a set of testing instruments consisting of Wheatstone bridge, galvanometer, relay, etc., and so determine the nature and approximate locality of the trouble. This chief inspector will have charge of all the "trouble men" attached to his exchange, and will keep full records of all incidents connected with the maintenance of the lines. In all exchanges, current for ringing up subscribers is supplied by small power generators run by electric motors; these are located in a separate department called the power room, which also contains a large battery of gravity cells to be used in connection with a pole changer in case of the motors or power generators being disabled at any time.

Needless to say that all these exchanges are equipped throughout on a basis of metallic circuit working; before very long, as indicated in this article, New York will be provided with a group of telephone exchanges embodying every appliance which the best telephone engineering talent in the country has been able to bring to bear upon the complex and many-sided problem of maintaining an efficient service of telephonic communication in such a city as New York.

If any newspaper scribe, before he lightly sits himself down to indite a diatribe against the niggardly economy of the telephone companies and their systematic suppression of improvements in methods and apparatus, would pay a visit to one of these exchanges he would find both methods and apparatus of a far higher standard than in many other technical establishments. Then let him figure out the cost of an eight-story telephone building, of a multiple switch board for 3,600 subscribers, of the distributing board, motors, generators and batteries, of the miles and miles of wire within the building and the miles of underground cable without, let him ponder over the cost of maintenance and the salaries of a staff which would fill a good-sized theatre, and if the calculation leaves him still with power to think he will think twice before informing the public that the telephone companies spend no money and merely plot day and night to achieve the difficult operation of catching whales with sprats.

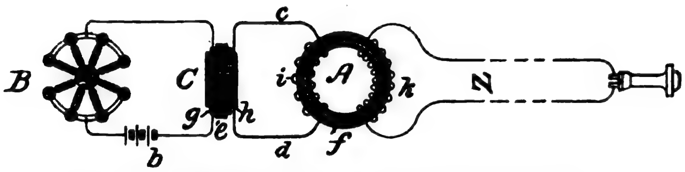


FIG. 1.—LOCKWOOD'S NEW SYSTEM OF TELEPHONY.

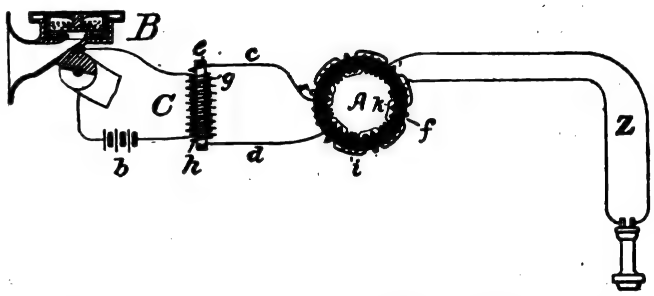


FIG. 2.—LOCKWOOD'S NEW SYSTEM OF TELEPHONY.

LOCKWOOD'S NEW SYSTEM OF TELEPHONY.

It has long been customary to employ induction-coils in connection with telephonic transmitters for the purpose of transforming the low-potential current of the energizing-battery into one of higher potential and better fitted to traverse the long line-conductor and to overcome its resistance with little loss of energy, as well as for the analogous purpose of very materially increasing the margin of variation producible by the operation of the transmitter. Up to the present time the induction coils employed for telephonic purposes have been almost universally made with cylindrical cores; that is, with open magnetic circuits. In contemplating the high efficiency attending the employment of induction coils or transformers of the closed circuit type used in electric lighting, welding, etc., Mr. T. D. Lockwood, the well-known electrician of Boston, has sought to employ such a form in telephony. But the employment of closed circuit induction coils in telephony involves certain considerations which do not appear at first sight. It is, of course, comparatively easy to operate electric light transformers by means of reversals of the primary

current, because, since the secondary currents to be evolved need have no special form, character, or quality, these reversals may readily be produced by using an alternating dynamo as a source and by sending its currents unrectified through the primary helix. But no such procedure is possible in telephony, for the voice-currents developed in the secondary circuit of the induction-coil, which are to traverse the line and reproduce speech at the distant station, must, so to speak, be an electrical copy of the variations of the sound-waves initiating them, and also of the sound-waves they are to reproduce. Up to the present time, however, it has not been found practicable to produce reversals in the primary circuit of transmitting telephone induction-coils, and in all such instruments which have gone into use the change which the operation of the transmitter effects in the primary circuit is not a reversal of current, and hence cannot result in a reversal of magnetism with its inherently-consequent zero moment. It is not even a succession of absolute cessations and emissions of current, as in the make and break of the Ruhmkorff induction-coils. The change which is effected by such operation is the variation of current strength, tending to produce a variation of magnetic intensity in the core, which, if produced, results in corresponding magneto-electric currents in the secondary helix and line; but the magnetism of an iron ring core once magnetized does not greatly vary when simple changes only are made in the strength of the magnetizing-current. Thus, while it tends to advantage to employ induction-coils having closed magnetic-circuit cores, such a procedure demands also a practical method of producing reversals in the primary circuit of the induction-coil, and it is to accomplish the latter object that Mr. Lockwood has designed the system we are about to describe.

The method employed is illustrated diagrammatically in Fig. 1. Here B is a multiple-contact microphone which is placed in the circuit of a battery, *b*, in which also is serially included the primary conductor, *g*, of the induction-coil, C. This circuit may be termed the "local circuit." The secondary conductor, *h*, of this coil has the same number of convolutions and is of the same size wire, and both are, as usual, wound upon a cylindrical core, *e*, of iron wires.

The induction-coil, A, has a continuous core, *f*, of soft iron, and constituting a closed magnetic circuit. This has a primary conductor, *i*, the same size and length as that employed in the two helices of the first coil, which is joined up in circuit with the secondary conductor, *h*, of induction-coil, C, and the closed circuit so constituted may be termed the "intermediate circuit." Thus alternating currents generated in conductor, *h*, inductively by changes of current in conductor, *g*, will be of like character with such changes, and will of necessity circulate in and through the primary conductor, *i*, of induction-coil, A. The resistance of the conductors, *g* and *h* and *i*, is low, being but a fraction of an ohm.

The secondary conductor, *k*, of coil A, is of fine wire, for the purpose of securing a great many convolutions, it being required not only to transfer electrical energy from the reversals circulating in *i* to the secondary conductor, *k*, but to raise the potential. The secondary, *k*, of the induction-coil, A, is connected with the wires of the main telephone-circuit, Z, leading to the distant station and telephone-receiver. The construction of the apparatus employed in actual practice by Mr. Lockwood is shown in Fig. 2. The position of the second induction-coil, A, and its connections are the same as those shown in Fig. 1, the only difference being in the method of winding. Here, it will be noted, the primary coil, I, is wound in alternate sections, spaces being left between each for similar sections of the secondary winding. The advantage of this method of winding is that the magnetization is thereby distributed uniformly, and is enabled to act equally upon all parts of the core.

It will be observed that the function of the first induction coil is to develop alternating currents in the intermediate circuit without raising the potential of such currents. If the potential in this circuit were to be raised, it would be necessary to multiply the convolutions of both the helices included in it, with a consequent increase in cost, in resistance, and in waste of energy. Furthermore, it is of great importance to keep down the resistance of this intermediate circuit, for the reason that in telephony self-induction is a potent factor in opposing the proper operation of the current, and the self-induction of any circuit of which coils or helices form a part is mainly dependent upon the number of their convolutions. Hence, there is special utility in employing a few convolutions of thick wire instead of a greater number of convolutions of thinner wire in the intermediate circuit.

ELECTRIC LIGHT MOLDINGS.

THE introduction of a new industry usually brings with it many collateral branches of new work and in this respect electric lighting constitutes a conspicuous example. Incandescent lighting once proved a practical success, a host of details had to be worked out to fit it for general use within doors, to make it safe against injury to person and property; and added to this safety, a harmony was required with the general surrounding of the premises in which the light was employed. Electric house wiring has, therefore, taken a prominent place in electrical work and certainly deserves most careful consideration for reasons which are obvious.

Electrical conductors run in houses require not only to be thoroughly well insulated electrically, but also to be protected from mechanical injury and from contact with deleterious influences. To effect the latter purpose the electric light molding occupies at the present time an important position. Its main object, of course, is to hold the circuit wires securely in position at the proper distance apart, while at the same time it is required to conform to some extent to the ornamentation of the apartments in which it is run. Imperviousness to moisture is also a great desideratum in this connection. The ready adaptability of wood as material to fill these conditions is obvious, and hence wood moldings have been employed to a very large extent in this class of work. The practice in this country has run largely to the employment of a molding, consisting of a base in which the grooves are cut to the size required and which are covered by a capping set into the base for a small distance, so as to be firmly secured; the nails or screws employed being merely used to hold the cap in place without taking any of the strain.

The various sizes and styles of molding in general use are illustrated in the accompanying chart, and represent those manufactured by Mr. Russell Johnson, of this city, to whose courtesy we are indebted for the use of the chart. While in this country the grooves in the base-boards are for the large part rectangular in character, those employed abroad, and especially in Germany, have rounded bottoms and corners. The practice abroad also is to employ straight cappings, not set into the base molding. The depth of the base moldings below the groove, as will be seen, is also a matter which is quite variable; those on some of the work being furnished by Mr. Johnson for the government cruisers now building are pine beams 4 x 6 inches and have one inch grooves cut in them for the wires, thus leaving 3 inches of solid backing behind the wires. The wood usually employed in this country is pine, though not infrequently poplar is employed for the purpose. The latter is almost universally employed abroad on account of the scarcity of pine there. The general cheapness of wood in this country has indeed made it possible for wood moldings to be profitably exported abroad, and quite a trade has developed in this direction. In addition to the standard sizes of molding which are illustrated in the accompanying chart, a large number of others have been made, to fulfill certain requirements, and we have seen moldings with a dozen grooves to

carry a number of main leads from the dynamo to the points of distribution. The various styles of ornamentation of the caps also provide a field for much variety of design and finish.

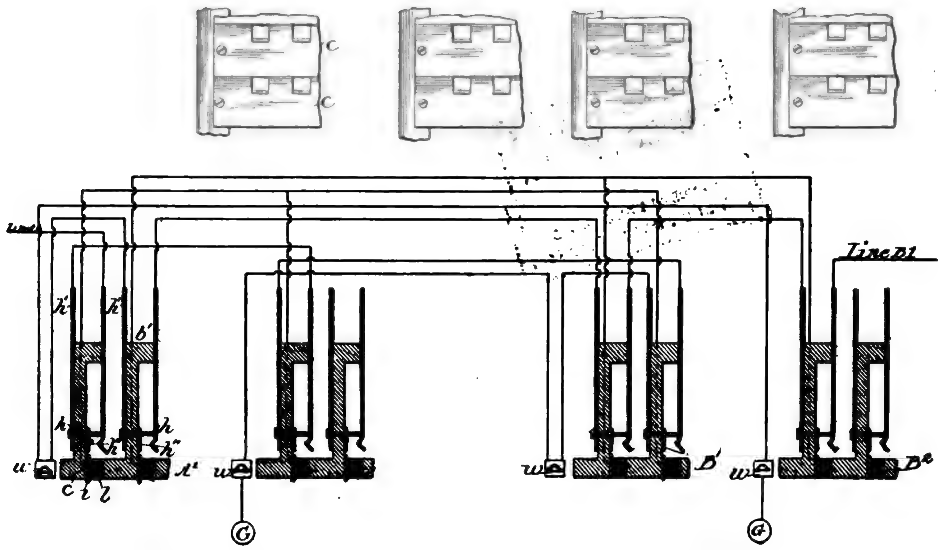
KELLOGG'S NEW MULTIPLE TELEPHONE SWITCH BOARD.

It is well known that multiple switch-board systems and apparatus as at present constructed and arranged become very expensive per line or subscriber where a very large number of subscribers' lines are operated in one multiple switch-board exchange. In these systems there is now usually provided one switch-board for about every 150 subscribers' lines. There is one spring-jack for each subscriber's line which belongs to the exchange. It is, therefore, evident, that, as the number of boards used in an exchange is increased as the number of subscribers' lines is increased, the number of switches for each line is correspondingly increased, and consequently the cost of the switches for a line is similarly increased. The number of switches used in an exchange of 5,000 subscribers' lines will be four times the number of switches used in an exchange of 2,500 subscribers' lines, and the number used in an exchange of 10,000 lines will be 16 times as great. Where more lines are used, the number of switches used per line will increase in like ratio. The number of lines which can be operated in one multiple switch-board exchange is, moreover, limited by the number of the spring-jacks which can be grouped on one board within convenient reach of an operator. It may be stated, approximately, that as the systems are at present constructed the number of lines which can be operated in one exchange is limited to about 10,000.

Recognizing the difficulties attending the service of a large number of subscribers and the great cost of switch-boards, Mr. Milo G. Kellogg, of Hyde Park, Ill., has recently designed an ingenious system by which he reduces by one-half the number of spring-jack switches which are required at each board, thus effecting a large saving in the cost of apparatus, and at the same time practically retains all the advantages which have heretofore been obtained in the multiple switch-board systems employed. The manner in which this is carried out will be apparent from the accompanying engravings. Here Figs. 1 and 2 represent a front and sectional view of several sections of the switch-board. This is so arranged that when a switch-plug is inserted into a switch-hole it raises the spring-lever in the rear of the hole from the contact-point on which it normally bears, and the flexible cord of the plug is connected with the spring-lever, while the contact-point and the contact-piece *i* of the switch are electrically connected through the medium of the switch-plug, which then touches both *i* and *h''* of the switch.

The calling annunciators or signal-receiving instruments, *w*, one for each line in each of the two sections of the exchange, are located at the boards where the calls of their lines are to be answered. These annunciators are polarized and their construction is shown in detail in Fig. 3. Each of these annunciators responds when one polarity of current passes over its line and does not respond when the other polarity of current passes over the line.

The apparatus at the subscriber's station is shown in Fig. 4. The generator is constructed with the usual automatic device, whereby it is shunted or switched from the line-circuit while not operated. The insulated contact-piece on the shaft of the armature, to which is connected one end of the armature-wire, and which conducts the generated current to the line through the stationary spring-contact provided for it, is a half-circle, the remaining part of the circle being of insulating material, as shown in Fig. 5. There is also provided a calling-key, *k*, with two pairs of contact-points, one pair being normally closed and the other pair normally open, and when the key is depressed the normally-open pair of contacts is closed and the normally-closed pair is opened. The connection of the key to the contact-springs of the generator and to the line-circuit is as follows: The spring-lever, which forms one of the contacts of each pair of contact-points, is connected with one side of the main-line circuit. The two other contact-pieces of the pairs of contact-points are connected to the two contact-springs, respectively.



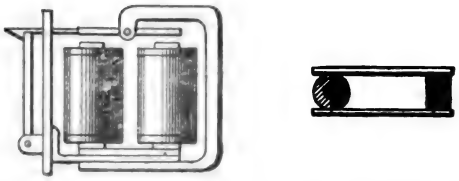
Figs. 1 and 2.—Kellogg's New Multiple Switch-Board.

Now, it is well known that when magneto-generators are operated a current of one polarity is generated during one half of the revolution of the armature and a current of the other polarity is generated during the other half of the revolution of the armature. It will, therefore, be apparent from the description of the subscriber's station apparatus which has been given, and from the circuits, that when the generator is being operated and the key remains in its normal position the armature-wire is in circuit through one only of the contact-springs, and a current of one polarity will be sent to the line; and that when the generator is being operated and the key is depressed the armature-wire is in circuit through the other contact-spring, and a current of the other polarity will be sent to the line. The subscriber can, therefore, at will send currents of either polarity to line, as he does not or does press on the calling-key. When his line is provided with two calling annunciators which respond to currents of opposite polarity, as shown,

one annunciator being located at a board in one section of the exchange and the other annunciator being located at a board in the other section of the exchange, he can at will call the operator at either board and not disturb the other operator.

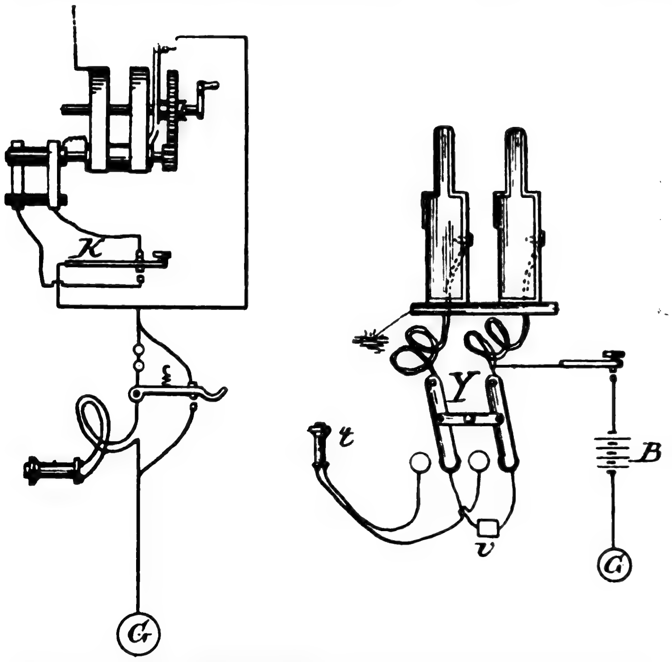
The operator's cord system, shown in Fig. 6, has a pair of cords with switch-plugs, a calling-key, a looping-in switch, and a clearing-out annunciator, and the usual telephone and calling-generator.

To carry out the organization it is necessary that each subscriber should be able to determine whether or not he is



Figs. 3 and 5.—Annunciator and Insulated Spindle of Magneto.

to press his calling-key when he calls for connection with any other subscriber. To accomplish this the subscribers whose lines belong to one class are indicated by some designation in the exchange list—as, for instance, their numbers may all be prefixed by the letter A. The subscribers which belong to the other class may also be designated in some manner—as, for instance, by the absence of any prefix or special mark. All the calling-keys are marked with the letter A. The apparatus and lines are so connected that when a subscriber desires connection with any line designated by the letter A he operates his generator while pressing on his calling-key marked A. When he desires



Figs. 4 and 6.—Subscriber's and Operator's Apparatus.

connection with any line of the other class, he operates his generator without pressing on the calling-key. This system of calling either board at will to which the subscriber may be connected therefore requires but one calling-key, and it requires the subscriber to press on the key only when he is calling one board.

It will be seen from the description of the main-line circuits and apparatus and of the operator's cord system that when two subscribers' lines are switched together at any board of the exchange by the insertion of the two plugs of any pair of cords into the switches of the line at that board the two calling-annunciators of each line are cut off or disconnected from the circuits of the line, and the operator may, by the use of the switch, Y, in Fig. 6, loop the clearing-out annunciator, *v*, into the combined circuit of the lines. The number of pairs of cords needed for the system will depend on the number of connections which are liable to be required at one time in the exchange. As a general thing one pair of cords to every eight or ten subscribers' lines will answer.

THE NEW TELEPHONE EXCHANGE, HARTFORD, CONN.

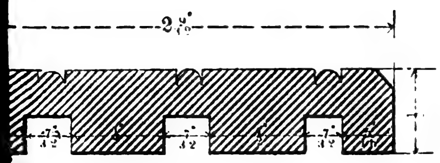
In the early days of telephony, exchanges were situated in the most convenient building available at the time, but the rapid increase in the number of subscribers which followed soon made such quarters not only inadequate of accommodation but developed inconvenience when the later improvements which were brought about were adopted. As a result the more progressive telephone companies have undertaken the erection of building specially adapted to exchange purposes, and some of these structures now rank among the finest buildings in our large cities.

Among such structures recently erected is the Telephone Building, at Hartford, Conn., built by the Southern New England Telephone Company. The building, which is shown in perspective in the accompanying engraving, Fig. 1. is situated on the southeast corner of Pearl and South Ann streets, on a lot fifty feet on Pearl street and running back about one hundred and twelve feet on South Ann street. The building occupies the entire Pearl street front and some seventy-eight feet of the depth of the lot. It is built of brick with granite and brown stone trimmings, and is most substantial in its construction. It is constructed on the slow-burning system; that is, the floors are of the beam and plank description, with protecting layers between the planking and the upper flooring, and the partition walls are of terra-cotta lumber, in place of scantlings.

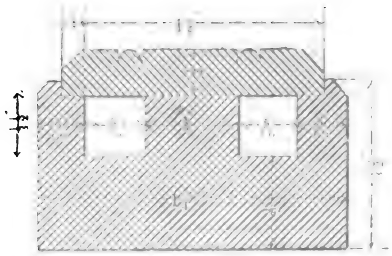
On the ground floor are two stores, running the entire depth of the building, which are entirely separated from the other parts of the building by brick walls. The second story floor is to be of plank, covered with an inch of fireproofing material, and on top of that the flooring proper. It is on this story that the business of the company is to be done. The business office will be in the corner room on the front. This will be the local manager's headquarters. A feature of this room will be the cabinets for the use of telephone users. On one side of the office will be built two cabinets, enclosed by plate glass, and made sound-proof, in which will be Long Distance telephones and all the conveniences for conversation with any of the cities that are connected with the Long Distance lines. The talker will be entirely protected against interference from outside noises, and also from being overheard while talking.

Across the entire rear of the second floor runs the operating room, as shown in the plan, Fig. 2. It is well lighted from the south and west, and is large enough to accommodate a switch board for three thousand subscribers. Adjoining the operating room is a parlor and toilet rooms for the young women who are employed in the room, well lighted and comfortable.

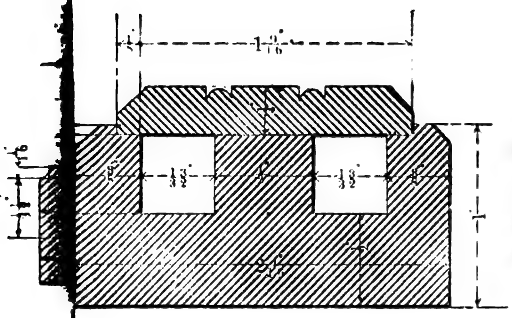
Between the operating room and the hall is the critical point in the exchange, the distributing room. This is the room into which all the wires of the system come before passing to the switch-board. The room is to be as nearly fireproof as the character of the building will permit. The walls are brick and terra cotta, the ceiling is metal lined, and the floor is asphaltum. One of the features of the room is this floor. It is waterproof as well as fireproof, and is graded to a scupper that leads to the shaft, so that it can at any time, in case of a sudden fire among the wires, be flooded with water without injury to the remainder of the building. On the outer side of the room will stand the distributing board. This is of a new design, the work of Mr. George A. Milliken, the electrical mechanic of the company, and Mr. E. B. Baker, the general superintendent. It is of Russia iron, with room for 1,000 pairs of



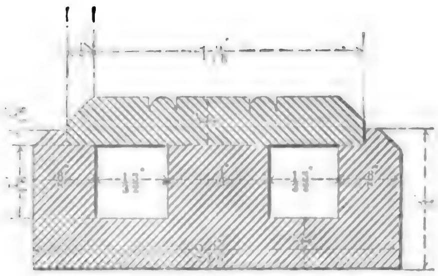
A 7



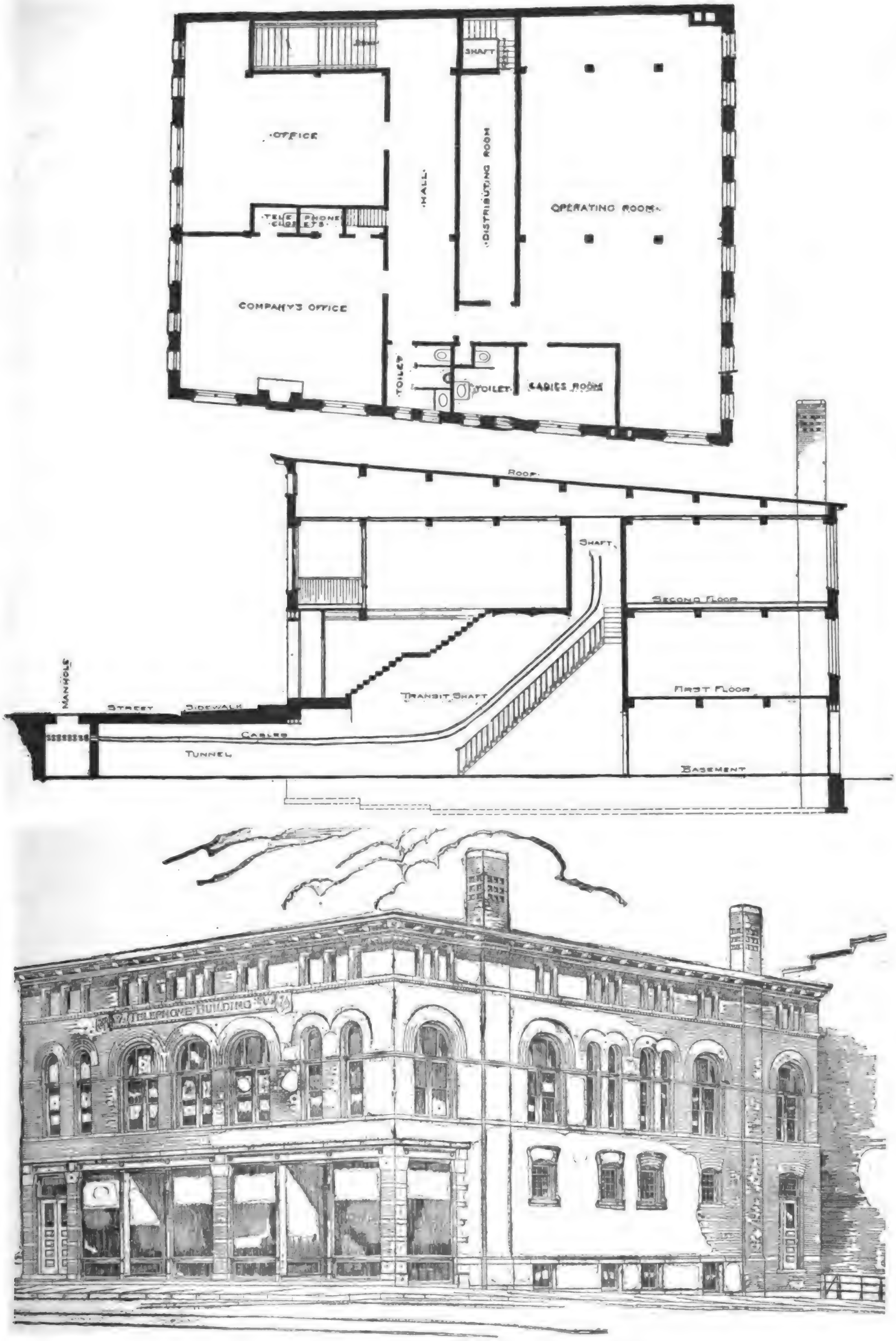
B 1



C 1



C 2



FIGS. 1, 2 AND 3.—THE NEW TELEPHONE EXCHANGE, HARTFORD, CONN.

(L. W. Robinson, Architect, New Haven, Conn.)

wires. It is in the form of a series of upright channels of sheet iron, bolted and riveted together, on one side of which the wires enter from the cable heads, that are just above it, and from the other side of which the wires run to the switch-board cables.

The switch-board is to be of the latest pattern of the multiple type, like that now in use in the company's building at New Haven, arranged for metallic circuits. It will have an ultimate capacity for more subscribers than the exchange will probably have in twenty years. Its cost is $5,000.

The feature of the building that the company takes the most satisfaction in is the manner in which the wires are brought into it.

The roof of the new building will not have a wire upon it. Everything is brought in from the underground ducts. On the east side of the building is a stone stairway, as shown in the section Fig. 3, enclosed in heavy brick walls. Under this stairway is a brick and cement walled passage, leading from the man-hole in Pearl street up to the floor of the operating story. Here the passage becomes a tight brick shaft, to the attic floor, and is there ended in a heavy flagging. It is through this passage that the cables of the company will be brought to a terminal board. At some distance back of the stone stairs, which form the principal entrance to the operating department, is a staircase of iron, running from the second story and opening into the terminal room, down to the floor of the fireproof passage, on a level with the cellar floor. The cables will be hung on the walls of this fireproof passage, and by means of this iron staircase will be within reach of the hand for the entire distance from the terminal room to the man-hole in the street. This is considered of the highest importance to the safety of the exchange.

This building, when completed and occupied, will have cost the company, with its equipment, over $40,000. The architect of the company is Mr. L. W. Robinson, of New Haven, and the contractors are Messrs. Whiton, Porteus & Co., of Hartford. It is expected that the building will be occupied in October.

But this central station is not by any means all that the telephone company has built in Hartford this year. It has commenced an entire revolution of its system of construction and of operation. Hitherto the business has been done on the grounded system, but for the new work the metallic circuit system will be adopted throughout. For the central masses of wires the underground conduit is used. The company has laid this summer 75,000 feet of underground duct in Hartford, and is preparing to connect all its wires with the outer terminals of the seven miles of cables that it has already drawn into these ducts. Some idea of the amount of work that has been done will be had when it is stated that there are now under the surface of the streets in Hartford more than 500 miles of insulated wire, and that when the work is completed there will be more than 700 miles. The cables used in Hartford are of the Faraday pattern, made by the American Electrical Works, at Providence.

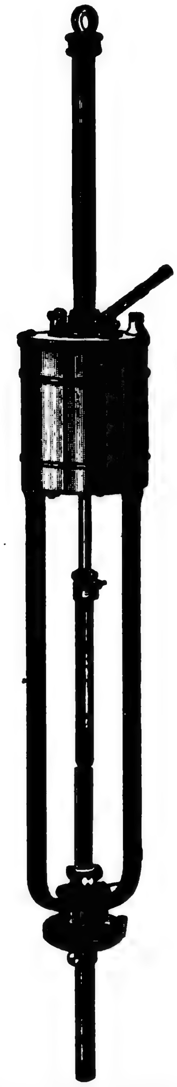
The underground ducts are of the Phipps cement lined iron pipe, laid in a matrix of cement, and running into man-holes at the corners of the streets. The man-holes of the company are all six feet square on the inside, built of twelve-inch brick walls, laid up in cement, and topped with heavy cast-iron covers. From these man-holes the cables are led through lateral ducts to the upper part of the company's poles, where they enter cable boxes and are distributed, as needed, to the subscribers.

In addition to the underground work this change of system involves an entire renewal of the overhead construction of the exchange, and this is now going on, the specifications being of the most approved character. The wires are of copper, there is a free use of cables and covered wire in difficult or dangerous places, and the equipment of the subscriber's station will be largely new. This work, aside from the building, will cost the company $60,000, or more, so that its total expenditure in this one place this season will be a good deal over $100,000.

THE NEW SPERRY TRIPLE CARBON ARC LAMP.

Among the novelties which attracted considerable attention at the late Cape May Convention was the new triple carbon arc lamp of the Sperry Electric Co., of Chicago, which was in operation on the circuit of the local electric light company.

The new lamp, which is illustrated in the accompanying engraving, consists of two ordinary circular carbons, which are clamped side by side in the upper holder of the lamp.



The Sperry Triple Carbon Arc Lamp.

This holder is a modification of the old single carbon form, so constructed as to firmly hold the two positive carbons in position. The lower carbon is a single flat piece with rounded edges, and only half the length of the upper carbons, as in all ordinary lamps, but of practically the same cross section as the two upper ones.

The play of the arc is quite interesting. Thus it starts between one of the upper carbons and the lower, and as it increases in length by the burning away of the carbon, it instantly jumps and forms between the second upper carbon and the lower, and so on. These alternations of position, however, are indistinguishable to the eye; and the lamp burns with the utmost steadiness.

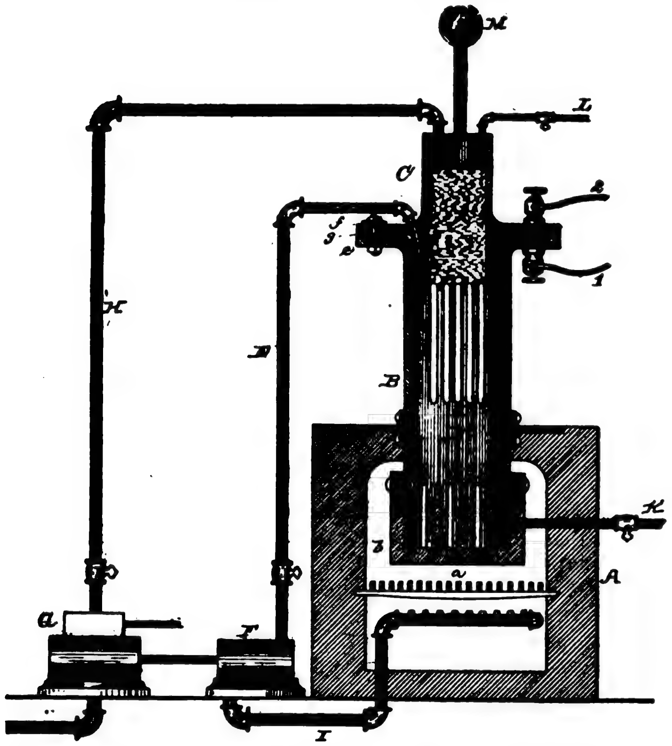
The clamp which holds the lower carbon is rectangular

in shape, substantially that of the carbon itself, and is fitted with adjusting screw and clamping piece, so as to always bring the carbons in line.

EDISON'S NOVEL GASEOUS GENERATOR.

The fertility of Mr. Edison's inventive genius cannot be better demonstrated than by reference to the numerous methods proposed by him for the generation of the electric current. In our last issue we had occasion to refer to two such methods proposed by him, and we would now call the attention of our readers to another, which, even if not likely to come into general use, is nevertheless quite interesting.

Electricity has been generated heretofore by chemical reactions in liquids, which acted as the conducting media, but Mr. Edison proposes to generate electricity by dry chemical reactions, and to use the gases liberated as the conducting media of the generating apparatus. This he is enabled to do by causing the dry chemical reaction to take



Edison's Gaseous Electric Generator.

place in a vacuum-chamber in a rarefied atmosphere forming the conducting medium, and in the presence of heat which maintains the chemical reaction and increases the electrical conductivity of the rarefied gas. Such compounds or compounds and elements are used that, under the conditions of heat and rarefaction employed, the chemical reaction which takes place within the inclosing-chamber will produce a solid or liquid, that is, a non-gaseous product, which remains at the point where the reaction takes place, and will liberate a gas which rises into the chamber. The inclosing-chamber being electrically divided into two parts, which form the poles or current-collectors of the apparatus, the non-gaseous product remains upon and charges one pole while the gaseous product charges the other pole. There is kept up a continual exhaustion of the chamber to maintain the proper degree of exhaustion as the reaction takes place.

A form of apparatus designed by Mr. Edison, in which these reactions could be carried out, is illustrated in the accompanying engraving. A tubular vessel B is supported on a furnace A, and on the bottom plate *b* are fixed upwardly projecting iron rods *c* which act as electrodes. The vessel B supports a steam boiler, C, the water tubes, *d*, of which project downwardly. It will also be noted that the two vessels are insulated by the asbestos packing *g*. The boiler closes the top of the vessel, forming a reaction chamber D, in which the chemical reaction takes place. Entering this chamber is a pipe E extending to the inlet of the air pump F; the latter is operated by the engine G which takes steam from the boiler. A pipe I extends from the outlet of the air-pump to the fire box of the furnace, and another pipe K admits water or steam to the chamber D. The circuit connections are made between the two vessels as shown.

A great variety of compounds or elements may be used in producing the chemical reactions described, since nearly all chemical reactions produce electricity under the proper conditions. A reducible or oxidizable substance can be employed, such as a metal or metalloid, acted upon by a gaseous, liquid or solid compound containing an element with which it will readily combine when the compound is decomposed; or a non-metallic material, like carbon, might be employed instead of the metal or metalloid.

An efficient method is to use a metal, such, for instance, as iron, in a divided condition, which is placed in the chamber and brought up to incandescence, and then to permit steam or water in the proper quantities to enter the chamber. The oxygen of the watery vapor will combine with the metal, and the hydrogen will be liberated, the chemical reaction setting up a current of electricity, the rarefied hydrogen charging one pole, while the other pole is charged by the iron. The operation is a continuous one until the metal is oxidized, the heat being kept up and the steam or water being permitted to flow into the chamber in a continuous jet.

Carbon in any form colud also be conveniently employed, such as charcoal, coke, lamp-black, or anthracite, or other coal mixed with a reducible oxide of a metal. Oxide of lead might also be mixed with carbon and placed in the chamber. As the heat is raised the oxygen of the oxide of lead will combine with the carbon, producing carbonic oxide and reducing the lead to the metallic form. The rarefied carbonic oxide passes into the chamber and charges one pole, while the metallic lead charges the other pole.

The hydrogen or carbonic oxide withdrawn continuously by the vacuum apparatus can be forced into the fire-box and burned as fuel for heating the chamber; or, where the gas is suitable for the purpose, it can be used for producing chemical reactions in other vacuum-chambers. Carbonic oxide, being a powerful reducing agent, is especially adapted for this purpose, and as withdrawn from one chamber could be used to reduce a metallic oxide in another chamber.

The chemical reactions in the apparatus can also be reversed, if desired. Thus metallic iron could be oxidized by admitting water or steam to the chamber, producing currents of electricity, and then charcoal could be placed in the chamber and the oxide reduced to a metallic form; or this could be done by the admission of carbonic oxide, this reaction also producing currents of electricity. The metallic iron may then be again oxidized, and these operations may be repeated indefinitely, the waste of the metal or oxide being made good, as found necessary.

THE BRITISH ASSOCIATION MEETING.

The British Association for the Advancement of Science held its annual meeting last week. Sir Frederick Abel, the president, in his address from the chair, made a survey of the strides of modern discovery and invention. He dwelt upon the use of electricity for motive purposes, as exemplified so remarkably in America, while England has been slow in this respect.

THE LECHNER ELECTRIC MINING MACHINE.

A trial of the Lechner electric mining machine, which is manufactured at Pittsburgh, was made at the Boston, Pa., coal mines of Capt. S. S. Brown recently. A number of gentlemen witnessed the work of the machine and were highly pleased. In five minutes a solid piece of coal three feet wide and four feet and a half deep was cut through. Captain Brown has been paying a good deal of attention to this machine lately, and will introduce it in all his coal works in the near future.

THE SWINBURNE "HEDGEHOG" TRANSFORMER.

LAST year Mr. James Swinburne brought forward the theory that an open iron circuit could be made more efficient than any form of closed iron circuit transformer. The loss in a transformer, he argues, is made up of loss in copper due to resistance, and loss in iron due to hysteresis. In calculating the efficiencies of transformers, the loss in the iron has generally been left completely out of account, and the loss in copper alone considered ; hence, the efficiencies of 97 and 98 per cent. claimed for closed iron circuit forms. If the loss by hysteresis is taken into account, allowing the losses as given by Ewing, the loss in iron in closed circuit transformers, as usually designed, is some 10 per cent. of

FIGS. 1 AND 2.—SWINBURNE'S "HEDGEHOG" TRANSFORMER.

the full load. As the loss in iron goes on all the time a transformer is in circuit, this is very serious. The proportion of actual to possible output of energy per day varies in different districts, but in most stations the average use of lamps is less than two hours a day, including all lamps installed. The transformer must be large enough to feed all the lamps installed, so it runs, say, on an average two hours at full load a day. If there is a loss of 10 per cent. at full load in the iron, this gives an actual efficiency of 45.5 per cent., even neglecting the loss in copper.

In the "hedgehog" form the proportion of iron is very much reduced. The cross section of the iron is much less, and the length is about one-third of that of the closed circuit form, as it has not to surround the wire. The result is that even in small transformers the iron loss is under one per cent. of the full load. One per cent. of the full load gives 89 per cent. all day efficiency, neglecting copper loss, against the 45 per cent. of the closed circuit. This is neglecting copper, however, and the copper loss is greater in the "hedgehog" form, so this is an exaggerated comparison. Such a transformer in reality, according to Mr. Swinburne, has an efficiency of about 87 per cent. all day.

The theory of the "hedgehog" form is this : If a closed iron circuit is used, the iron circuit must be long to embrace the copper coils. The only way to shorten it is to make the copper coils smaller. This means using a higher current density, which is wasteful, or fewer turns of copper. Fewer turns of copper demand either a higher induction in the iron or a greater cross section, and either of these means greater loss by hysteresis. If the iron circuit is opened, the sides of the embracing core can be removed, so the loss by hysteresis is divided by three. As there is now plenty of room for the copper, the turns and cross section can be increased and the iron reduced still farther.

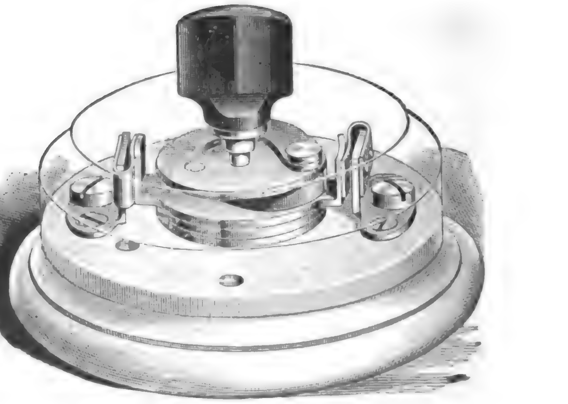
The object of introducing the closed iron circuit was to reduce the magnetic resistance. An open circuit transformer has much higher magnetic resistance, but, according to Mr. Swinburne, the question of magnetic resistance is not so important as might at first sight appear. Its increase demands more excitation, or more magneto-motive force, and this increases the loss in copper. The best form is thus a compromise, and the "hedgehog" ends are employed to reduce the magnetic resistance. In a conductive circuit the resistance is low if the current density is low in all parts where the specific resistance is high. Similarly, in a composite magnetic circuit of iron and air, the magnetic resistance is low if there is never a high magnetic current density or induction in the air, which has high specific magnetic resistance. The magnetizing current in a "hedgehog" is high, but as it is a quarter of a period behind the primary current in phase, and as the primary wire has to be large enough to carry the primary current, the loss in watts is small. As this loss goes on all day, however, it is by no means unimportant, and has to be included in getting out the efficiencies of these transformers.

The construction of these transformers as carried out by Messrs. Swinburne & Co., of Teddington, England, is very simple. A gun metal casting of cross shaped section forms the backbone. It is spread out at each end, forming legs at one and taking the circular terminal board at the other. It also carries insulating flanges, which form the ends of the coils. Into the four recesses of the core are put four bundles of soft iron wire. These are taped over, and the secondary is wound on. The secondary is then covered with two layers of ebonite, and the flanges are also faced with the same material. The primary is then wound on in two compartments separated with ebonite after the manner invented by Gramme, so that both ends come outside, and as far removed from each other as possible. The ends of the core are then spread out, as shown in Fig. 1, and the transformer tested under 4,000 or 5,000 volts, the insulation in megohms being read by a peculiar instrument which measures the effective resistance under an alternating current.

Iron cases cannot be used, as they would be magnetized by the transformer ; and, as any metal would have Foucault currents generated in it, stoneware jars are used for cases. These have lids bolted down, with holes for the leads, as shown in the engraving, Fig. 2.

THE HART SNAP SWITCH.

AMONG the novelties shown at the late Cape May convention was a snap switch designed by Mr. Gerald W. Hart, superintendent of the Edison Electric Light and Power Co., Kansas City, Mo. The switch, which is illustrated in the accompanying engraving, is so constructed that it performs a rotary movement in one direction by quarter turns, and snaps full on, or off, without being able



THE HART SNAP SWITCH.

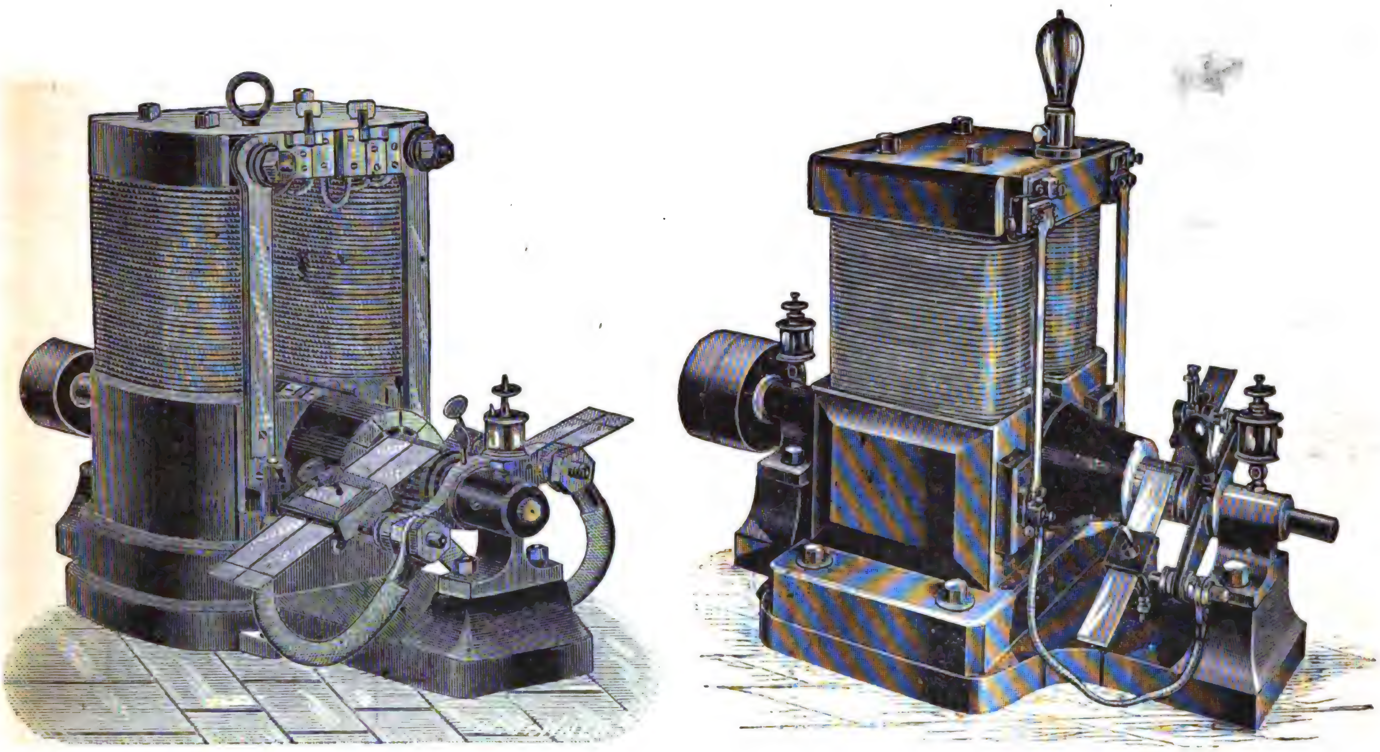
to stop at any intermediate position. This is accomplished by the employment of a curved steel spring, which accumulates tension as the switch knob is turned and is then suddenly released and moves the contact independently of the switch knob.

As will be seen, the current entering at the spring contacts passes into the connecting piece, which is of large surface and of ample carrying capacity, and the current is not required to pass through any pivots or springs. The

break, of course, is a double one, and the breaking distance very large for the size of the switch, so much so that it can be used with impunity on a 500 volt circuit. The engraving shows the 10 ampere switch in full size. The switch is now being manufactured by the Hart & Hegeman M'f'g. Co., of Kansas City, Mo.

THE KING DYNAMOS.

Among the recent additions to the dynamo machines now being built, are those of the Detroit Dynamo Co., of Detroit, Mich., which have been designed by their electrician, Mr. W. R. King. The dynamo intended for electroplating is illustrated in the accompanying engraving, Fig. 1. In this machine the perfect electric balance maintained in the armature prevents all sparking at the commutator. By the method of construction adopted and by the use of compound winding, the electromotive force of the machine is kept practically constant at all loads, so that the quality of the work is independent of the amount



Figs. 1 and 2.—The King Electro-Plating and Incandescent Dynamos.

of pieces in the bath. Besides making the use of a separate exciter unnecessary, the reversal of the machine is also prevented by the construction adopted.

The incandescent machine built by the same company is shown in Fig. 2, and is also entirely automatic in its regulation, maintaining potential constant, whether one lamp is in circuit or the full load is on the machine. The voltage of the machine is such that arc as well as incandescent lamps can be placed directly on the circuits. These machines have been installed in a number of works in Western cities.

A LOCOMOTIVE RUNS DOWN AN ELECTRIC CAR.

At Cleveland, O , on Sept. 6, a bad accident occurred on the Williston avenue electric road, an electric motor car and trailer being run into by a locomotive at a crossing. No warning had been given of the locomotive's approach. A woman was killed and twelve persons were injured in the collision.

ELECTRIC RAILWAY STRIKE AT WHEELING, W. VA.

The electric railway service at Wheeling has been suspended for several days owing to a strike. The tracks have been obstructed and the police have refused to man the cars.

HOW THE INTEREST MAY BE INCREASED IN A SCIENTIFIC SOCIETY.

BY J. P. WINTRINGHAM.

The primary idea of a scientific society is that the speakers shall bring before it some new discovery or invention or principle. But the field having been pretty well covered at this age of the world, at least as far as the more elementary matters are concerned, it becomes a task that few have the ability to accomplish. You can hardly expect to have the services of those who have this ability unless the society publishes its transactions.

A second object of a society may be considered to be to show in detail the various methods of doing all classes of work that comes within the scope of the society. Not that others do not know how to do the same thing, perhaps as well or better, but because each one is likely to have some novelty about some of the details of any operation that is superior to the more common method.

It would, I believe, be an attractive feature to any such society to have all new experiments repeated before it. If the society had to buy the apparatus for such work it might be very expensive, but doubtless amongst the many members a large part of the apparatus might be found, unless the new experiment involved novel apparatus. The want being understood, no doubt the members would offer to allow the society the use of such as they have, and often dealers would be glad to exhibit novelties. I believe there is a society in England that has this idea for its object (Experimental Society).

I am inclined to recommend that the society should have each alternate meeting devoted to a systematic course of lectures or studies, beginning with the elements of the subject and carried as far as time allowed. Not that we should have some master present the subject to us in its entirety, but that some member should offer to write out a fair presentation of the subject of the evening, or should take from some published essay or text book that part wanted, to occupy half an hour to an hour's time. The main feature to be a full, thorough discussion by the members of every obscure point or part little understood. Or, to put it differently, to have the members compare their

various conceptions; for some would have perfected and elaborated their ideas so much more than others that it would be to our great gain to know what they thought. I might instance the attribute Mr. Mailloux gives to the magnetic lines of force. I believe the conceptions of most of us are flat and often narrow, rather than full and rounded, as they should be. And they can perhaps only be perfected by contact with the views of others.

The ordinary reading of papers does not allow much chance for discussion, because only the writer knows what is to be presented, and others cannot be prepared to make a reply except on the spur of the moment.

I think every scientific society should arrange to have notices of its meetings, and, if possible, the subject of papers coming before it, appear in appropriate periodicals under the head of a diary. It would increase the attendance and also would encourage those who prepared papers to be read.

THE NEW "LAW" SWITCHBOARD FOR PHILADELPHIA.

The Bell Telephone Company, of Philadelphia, have recently erected a new building of their own at 406 Market street, in that city, running through to Merchant street. It is 35 feet wide with a depth of 119 feet from front to rear. It is four stories and basement in height and each story is of unusually lofty pitch, so that the edifice is really as high as many buildings that boast nearly double the number of stories. The building is occupied exclusively by the Telephone Company and was designed with a single eye to their use. It is fire-proof in every sense of the word; in the basement is a remarkably complete plant for lighting, heating and ventilating, and the conductors enter underground from a system of conduits that ramifies throughout the whole city. This system, it may be mentioned incidentally, is partly of iron pipe and partly of "indurated pipe," the latter of which has received Dr. S. M. Plush's enthusiastic praise. The blocks of buildings in Philadelphia are intersected by narrow lanes. In each lane is placed a distributing pole to which the conduit runs. The cable is carried thence up the pole in a pipe and the services are taken off for each subscriber in the block.

Coming back to the exchange, we find the cables passing in from the street through a large tunnel. The cables are carried up some distance, pass to the lightning arresters, thence to the distributing or cross-connection board and thus at last to the new switchboard.

The Law Telephone Company, of this city, are building the board or table, and expect to have it in operation by November. Its cost will reach not far from $100,000, and it will have a capacity of 10,000 subscribers. It will be in 30 sections, each having a capacity of 10,000 subscribers, and each accommodating two operators. The board is being wired up on the metallic circuit plan, and the whole of the 10,000 metallic circuits go into a space 30 inches wide by 36 inches long. This seems incredible, but "seeing is believing." At the start the board will be fully wired up for 6,000 subscribers. Much ingenuity has necessarily been shown in this economy of space and material, but owing to the exigencies of patent questions, we can only just hint at a few novel details. One peculiar feature is that in building up the sections, which look for all the world like slices of square black honeycomb, the rubber has been vulcanized on the metal parts of the board instead of being rivetted or screwed on as heretofore. This is quite new in the art and proves very successful. A second special feature is the weaving of the wires in a broad flat band, and carrying them through the board in that shape. A third feature is that of fastening the wires to the sockets by pinning or pressure, instead of soldering or screwing. Another feature has been the provision made by square chambers, lined with aluminum in place of brass for maintaining the sliding contacts for the operator's plugs. Yet another new departure has been the use of iron for the framework of the board, giving economy in more than one direction. All told, Mr. Childs says, the gain in space as compared with what has been done before is so great that not a quarter as much will be required. It is claimed that in the boards, of which the most conspicuous example is illustrated in this issue of The Electrical Engineer, it is impossible to bring even 6,000 multiple connections within reach of the operator; whereas, here are found 10,000 bunched for most comfortable and convenient handling.

The Reed's Lake Electric Railway, Grand Rapids, Mich. (See page 285).

"Laying Ocean Cables."—The article on this subject by H. L. Webb will, it is now announced, appear in the October *Scribner's Magazine.* It will be the leading illustrated article.

THE REED'S LAKE ELECTRIC RAILWAY.

One of the more recent electric railways which has made a record for itself is that just installed at Grand Rapids, Mich., by the United Electric Traction Co., of this city. The Reed's Lake Electric Railway, as it is called, is 2¾ miles in length. It was started on August 6th, and has been since in successful operation. The motors are the company's new standard 30 h. p. type, and propel the cars at an average speed of 18 miles per hour, with maximum gradients of 3½%. There were 197 passengers on the two cars when the picture from which the accompanying cut was made was taken. The greatest number of passengers carried as one load, so far, is 223, and the greatest number hauled in one day with one motor, 2,331. The average daily run of each train is 105 miles. The motor cars are 26 feet long, and the trailers are 35 feet over all. Each motor carries one trailer.

Great credit is due Mr. V. H. Yarnall of the U. E. T. Co., who superintended the construction of the line.

The station outfit consists of two Mansfield Machine Co.'s boilers, one Taylor 100 h. p. engine, three 50 h. p. U. E. T. Co.'s compound dynamos (one reserve) and a very complete switchboard.

OBSERVATIONS ON CURRENTS ORIGINATING IN AERIAL TELEGRAPH CONDUCTORS.[1]

BY A. R. BENNETT.

USERS of telephones connected by single wires are familiar with the variety of noises which are generally present even when the line is only a few hundred yards long. It is difficult to find a wire which can be said to be even approximately silent at all times. The origins of some of the foreign currents, which the presence of these noises indicates, have been explained by Preece, Lockwood and others.

Recently in a test of some overhead copper and iron wires, stretched upon the same poles, for capacity by charge and discharge, using a sensitive reflecting galvanometer, the presence of currents which could not be accounted for by any accepted explanation was noted, and investigation was commenced.

It was noticed that soon after the commencement of rain, a

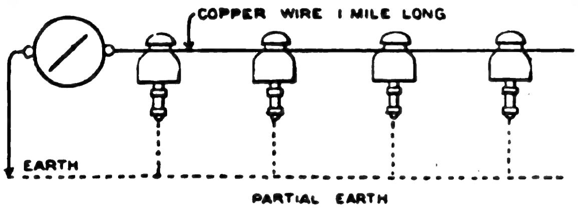


FIG. 1.

steady current appeared in all the wires under test. The deflections increased as the rain continued, until, after the thorough soaking of several days of storm, they were in some cases no longer within range of the scale. A constant discrepancy in the behavior of copper and iron wires was apparent. The deflections from the copper were always positive, while those from the iron were always negative, and as invariably much feebler, seldom exceeding one-third the strength of the positive ones.

To ascertain the cause, two wires, one No. 12½ copper, and the other No. 11 galvanized iron, run side by side on the same arms for the distance of a mile (Fig. 4), were taken. In fine weather the insulation resistance of each was infinite.

When disconnected at the farther ends and earthed at the home end through the reflecting galvanometer (Fig. 1), they always in wet weather exhibited the phenomena described.

The following are extracts from the records of tests extending over several months, during medium and heavy rain :—

Copper.—Always positive.		Iron.—Always negative.	
Degrees.	Value of deflections in milliamperes.	Degrees.	Value of deflections in milliamperes.
4.5	.0030375	1.5	.0010125
13.	.008775	3.75	.00253125
20.5	.0138375	4.	.002700
17.	.011475	3.	.002025
15.	.010125	4.5	.0030375
3.	.002025	.5	.0003375
46.	.031050	17.5	.0118125
22.	.014850	7.	.004725
14.5	.0097875	3.5	.0023625

1. Abstract of paper read at the special meeting of the Institute of Electrical Engineers, held in the Lecture Hall, Edinburgh International Exhibition, July 15, 1890.

It will be observed that the copper deflections were always from three to six times stronger than the iron ones. When the copper and iron wires were left insulated at their distant ends, and looped through the galvanometer (Fig. 2), earth being excluded, the positive and negative deflections were always equal. Thus, taking the last three of the foregoing tests, when looped 46 + 17.5 — became 35 + 35 — ; 22 + 7 — became 12.5 + 12.5 — ; 14.5 + 3.5 — became 9.7 + 9.7 —.

Half a dozen insulators with galvanized iron bolts were mounted on an arm in the testing room, and thoroughly wetted

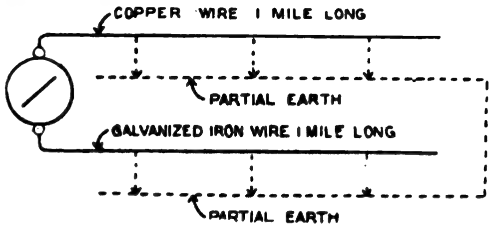


FIG. 2.

(Fig. 3). With a copper wire run on them, and the bolts connected, as shown, a positive current appeared as soon as a film of water was established between the wire and the bolt. With an iron wire instead of the copper no current appeared.

The positive current, therefore, seemed to be due to voltaic action between the copper wire on the insulators and the galvanized iron bolts supporting them when connected with the moist surface. The course of the current can be traced in Fig. 1. The wire and insulator bolts form a series of voltaic cells joined in parallel.

The absence of a current from the iron when mounted on the experimental arm confirmed this conclusion, since no current was

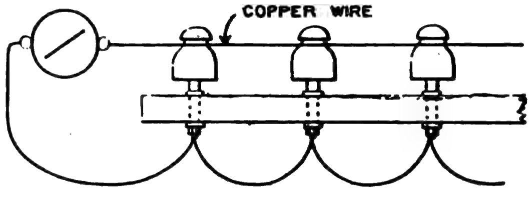


FIG. 3.

to be expected under the conditions. But whence, then, the negative current from the iron wire run on the actual poles? In that case it had a copper wire strung alongside it (Fig. 4). The wetting of both insulators established the connection necessary for electrolytic conduction between them, so that the metals constituted a voltaic couple, the negative current from which appeared on the iron.

The positive current on the copper was consequently due to the copper wire acting with the iron bolts of its own insulators, the iron bolts of the neighboring insulators and the iron wire which they supported.

The negative current on the iron was due to the iron wire, its

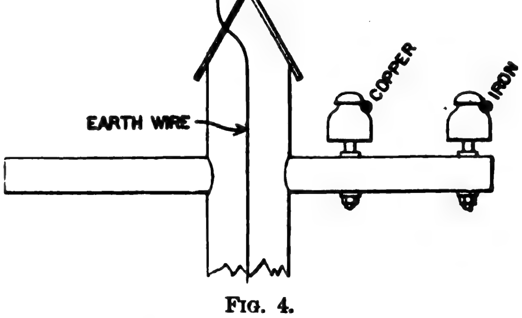


FIG. 4.

bolts, and the bolts of the neighboring insulators, acting with the copper wire. But the bolts of the insulators (Fig. 4) were partially earthed by the damp wood of the poles and the earth wires which ran down them. If the earth had been perfect no current could have got to the galvanometer, but since it was only partial some found its way by that route; and so the difference in strength between the positive and negative currents is accounted for.

The positive, depending chiefly on the action between the copper wire and its own bolts, between which no earth intervenes, is necessarily stronger than the negative, which depends wholly on the action between the iron wire and bolts and the copper wire between which a partial earth is interposed (Fig. 5). So when the earth is cut off from the galvanometer (Fig. 2), the effect of the

earth between the two plates is neutralized, and the positive and negative deflections become equal.

A somewhat unexpected effect of the recent introduction of copper wires for telegraph and telephone purposes is consequently the establishment over the country of a vast number of voltaic couples, which only become operative in damp or wet weather.

The zinc of the bolts of insulators carrying copper and bronze wires may reasonably be expected to disappear sooner than in days gone by, when only iron wire was used; and when copper and iron wires are run on the same poles the galvanizing of the iron must suffer sooner than of yore.

The Americans, with the wooden pins, will escape the currents

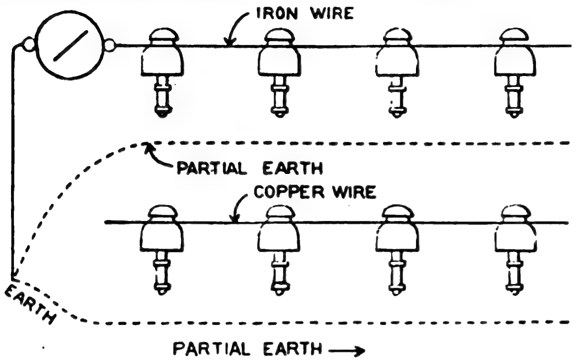


FIG. 5.

due to the difference of metal between the wire and its supports; but when they mix wires of different metals on the same poles the resulting action will be stronger than with us, since they do not earth-wire their posts.

Telephonically, the existence of these currents is of little moment. With metallic loops when both wires are of the same metal, they will not matter at all, since the currents from two similar wires will be in the same direction and of the same strength, and, meeting in the telephone or translator, will neutralize one another.

On single wires, so long as the currents remain steady, their presence does not matter much. As they increase gradually as the insulators become wet, and die away slowly as they dry, they

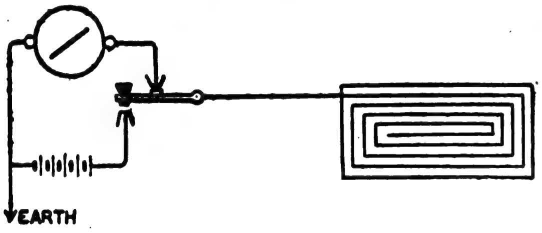


FIG. 6.

do not give rise to any disturbance in the telephone. If any confirmation of the voltaic origin of these currents were needed, it would be afforded in the fact that it is possible by changing the line from a battery, to polarize the line couple even to the extent of obtaining temporary currents of the opposite sign. Thus, the copper was repeatedly charged from a 90-volt battery; when from the positive pole the line current was increased, when from the negative the line current was decreased and sometimes reversed.

The following are particulars of several tests of the copper wire, the deflections being in degrees:—

Charging wire from 90 volts, etc., to line so as to neutralize and overcome line current.

Line current.	Duration of charge.	Result.
.5 +	10 seconds.	Reversed to .2 —
.6 +	20 seconds.	Reduced to 5 +
8.4 +	4 minutes.	Reduced to 3.5 +
12.5 +	10 seconds.	Reversed to .2 —
	Spot went back instantly to 5 +, and then recovered slowly to 12.5 +	
12.5 +	20 seconds.	Reversed to .4 —
	Went back quickly at first, and then slowly recovered to 12.5 + in 45 seconds.	
12.5 +	1 minute.	Reversed to .8 —
	Went back instantly to 3.5 +, recovering slowly to 12.5 in 70 seconds.	
12.5 +	2 minutes.	Same as 1 minute.
12.5 +	3 minutes.	Same as 1 minute.

The same effects were produced with the experimental arm. With only one insulator, reversed, the cup being full of water and the surface well wetted, a deflection was got of 4 degrees, equal to .0027 milliamperes. When the current from this insulator was reduced to .2 + through the surface drying, a reversal could always be obtained to .4 —, and sometimes to .6 —, by charging it from 90 volts —.

During the capacity tests already mentioned, it was observed that for some time after the commencement of rain, the apparent capacity of the wire invariably rose, instead of falling with the decrease of insulation. This effect has, of course, been noticed before, but, as the author was not aware that it had been satisfactorily accounted for, it was resolved to investigate, and the result of the investigation seems to point to several contributory causes. Firstly, no doubt, the line current due to the voltaic action already

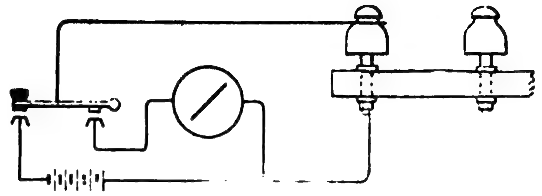


FIG. 7 A.

described will increase or diminish the discharge according to the direction of the charging current. Secondly, the polarization of the bolts due to the charging current will have the same tendency. But the capacity of the line will appear too high when the moisture on the insulators is too slight to permit a voltaic action. To seek the cause of this, 12 feet of copper wire was run on six dry insulators fixed in oaken arms in the test room. With 90 volts the wire gave a discharge of .4 degree. The tops of the insulators around the binding wire were wiped with a wet sponge. The discharge then rose to 1 degree, more than double. Wetting more of the surface of the insulators resulted in a still further increase. Several discharges could be got without renewing the battery charge. It would, therefore, appear that wetting the insulators

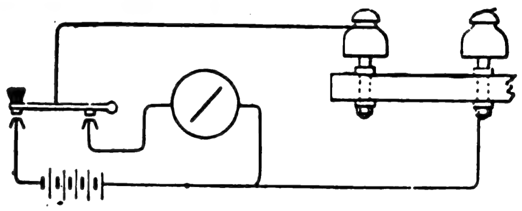


FIG. 7 B.

is equivalent to an increase of conductor surface. The moisture has to be charged as well as the wire, and the consequent discharge is greater than with a dry wire. The effect is only observable in moderate rain, or for some little time after the commencement of heavy rain; when the insulators become thoroughly wet the insulation and the capacity fall together, and then the voltaic action and polarization come into play together with another phenomenon which has not yet been referred to.

Incidentally, in the course of these tests, it was found that when

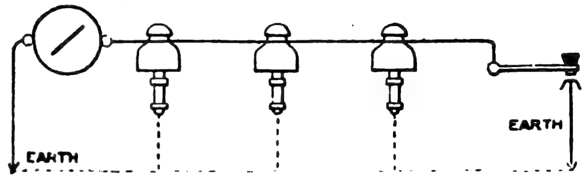


FIG. 8.

a wire is in contact with moist wood, and is charged from a powerful battery (90 volts were used), the discharge is several times stronger than when the same wire is supported on dry or partially moist insulators. Thus a length of wire on insulators gave a discharge of .9 degree; when fastened along an oaken arm not sensibly damp, with staples of the same metal as the wire, the discharge, after 20 seconds charge, amounted to 4.5 degrees, and after 80 seconds to 5 degrees. Then a residual charge appeared to remain in the wood, as the wire continued to yield a current of .5 degree for some minutes, then gradually dying away to nothing. Many tests, varied in details, gave the same results; 30 feet of wire in air gave a discharge of .4 degree. When the same wire was stapled on a deal board (Fig. 6) not sensibly damp, the discharge became 3.5 degrees, falling immediately to 1 degree, and then slowly to zero. The wire and the wood were then sponged and the discharge rose to 7 degrees, falling immediately to 2 degrees, and returning slowly to zero. The wire yielded a series of smaller discharges for several minutes without any fresh contact with the battery. A deal box wetted, having some bronze

wire in contact with it, was well insulated by being suspended by G. P. Charged for 20 seconds from 90 volts, it gave a discharge of 1.6 degrees, sinking immediately to .8 degree, and then gradually to zero. The same box standing on the floor, gave a discharge, under the same conditions, of 12 degrees, sinking to 3 degrees, and then slowly to zero. The same box touched by the end of an earth wire—also of bronze—well away from the bronze wire, gave a discharge of 45 degrees, sinking immediately to 26 degrees, and thereafter slowly to zero. In the two first cases only one metallic conductor, that is to say, the bronze, through which the charge was communicated, was present, and the source of the return current is not very apparent.

The last case closely resembles a wet telegraph pole, the earth wire of which does not touch the bolts. Then an expanse of wet wood intervenes between the bolts and the earth, and a powerful charging current in the line must, with leaky insulators, result in back currents. As it is evident that moisture in wood has the effect of increasing the capacity, it may not be unreasonable to deduce that moisture in the air surrounding the wire may have the same effect.

The foregoing particulars apply whether the line is of copper or of iron; the following observation applies to iron alone.

It has been mentioned that no current between a galvanized iron wire on a wet insulator and the bolt could be detected. But if such a wire is charged by 90 volts, the discharge is followed by a counter current from the insulator. The effect can be produced with a few inches of galvanized iron wire and a wet insulator, as in Fig. 7 A. Charging such an arrangement by 90 volts yielded a discharge of .4 degree and a counter current of .3 degree, which did not wholly disappear for some three minutes. Obviously, the polarization of the bolt following on electrolysis of the moisture made the insulator a secondary battery. The effect of damp wood may be markedly shown by shifting the return wire to the bolt of an adjoining insulator, as in Fig. 7 B. The discharge then became 1.5 degrees, and the counter current 1 degree, an augmentation of nearly four times.

Connecting the earth wire direct to the bolts will obviate the effect of moist wood, but it increases the strength of the voltaic action and the polarization of bolts by the charging current.

Although the Americans escape the voltaic action consequent on the use of metallic bolts, the damp wood of their poles cannot be without its effect in wet weather with the insulators they use.

The current set up between copper wire and iron bolts in wet weather might be used to signal with. The experiment has not been tried, but it seems plain that a galvanometer at A, Fig. 8,[2] through which the line current circulates in its full strength when the wire is insulated would be affected, for the key when closed would shunt a large proportion of the current around the galvanometer.

It will be observed that these experiments were made with the distant ends insulated, a condition which does not obtain in ordinary telegraphy. The practical effect of the disturbances may be insignificant, especially with double current working but still it is well to know that they exist.

Note.—Since reading the paper it has occurred to the author that the probability of this conclusion—that aimed at in paragraph commencing "The last case closely resembles"—is strengthened by considering that dry and moist air have very different capacities for heat. Tyndall found that, the absorption of heat by dry air being taken as unity, the air of his laboratory, not especially damp, had a relative absorption of 72, and that of air designedly moistened to be not less than 90. Thermal and electrical vibrations differ only in frequency, so that some common absorptive action in respect to air may be looked for. The heat absorbed by the moisture in the air is, after the withdrawal of the source of heat, radiated or discharged, not instantly but gradually, just as the electrical charge after cutting out a battery is parted with slowly and by degrees, as indicated by the residual charge. It may be expected, therefore, that the apparent capacity of a conductor will be least when surrounded by artificially dried air.

EFFECTS OF ELECTRICITY AND OZONE ON MILK.

It is well known, says the London *Times*, that during thunderstorms milk tends to grow acid. An Italian, Prof. G. Tolomei, has lately tried to throw some light on the nature of this action. He experimented with electricity on fresh milk in three different ways—first, by passing the discharge of a Holtz machine between two balls of platinum inserted nearly two inches apart in a bottle containing milk; second, by sending a battery current between two strips of platinum at the bottom of a U tube holding milk; and, third, by subjecting milk in a test tube to the action of a strong battery current through a silk-covered copper wire wound spirally round the tube. In each case the acidulation was delayed, not hastened. Three equal portions of milk from the same milking, thus treated, began to grow acid on the seventh, the ninth, and the sixth day, respectively; while milk not treated with electricity was manifestly acid on the third day. The electrified milk (unlike milk that has been heated to a high temperature, then cooled) coagulates naturally, or by action of rennet, just like ordinary milk. Having thus seen that electricity could not be the direct cause of acidification of milk, the Professor next tried the effect of ozone, and found it distinctly acidifying. In one case the surface of a quantity of milk was brought close under the two balls of a Holtz machine, and the milk soon became acid in consequence, the sooner if the discharge was silent (not explosive), in which case more ozone formed. In another case ozonized oxygen was made to bubble up through a quantity of milk, which in a few hours was completely acid and soon coagulated spontaneously. Prof. Tolomei is of opinion that oxygen probably also promotes lactic fermentation (a point which has been disputed). If milk keeps longer in wide shallow vessels, that is probably due, he thinks, to the cooling produced by evaporation, which is favored by a wide open surface.

[2] There is no lettering on the drawings furnished.—EDS.

SOCIETY AND CLUB NOTES.

THE NATIONAL TELEPHONE EXCHANGE ASSOCIATION.

The above Association will, as previously announced, be in annual convention this week at the Russell House, Detroit. The sessions begin on Tuesday, and will last, it is expected, until Thursday. A banquet will be given on Wednesday evening. Messrs. W. A. Jackson and F. A. Forbes are the local committee.

THE NEW YORK STREET RAILWAY ASSOCIATION.

This Association will hold its Eighth annual meeting at the Powers Hotel, Rochester, N. Y., on September 16. A report on electricity in street railway service will be presented by J. W. McNamara, president of the Albany Railway, and the representatives of electric railway systems have been specially invited to be present.

THE NEW YORK ELECTRIC CLUB.

The fall and winter meetings of the club will begin with a subscription dinner at the Club House on October 2, at 7 p. m. The dinner will be given provided 80 seats are engaged by Sept. 25. The charge, including wines, will be $5 per cover. Each member is at liberty to bring one friend as his guest. The dinner will be followed by speeches, recitations, music, etc., and President Madden has every right to expect a large gathering on this festive occasion.

THE ASSOCIATION OF EDISON ILLUMINATING COMPANIES.

Mr. W. J. Jenks, the secretary of the Association, has issued his notice of the convention to be held at Minneapolis on Tuesday, September 16, and following days, at the West Hotel. Among the topics to be discussed are: Lightning Protection; Insurance of Edison Central Stations; A National Code of Insurance Rules; Edison Patent Litigation; Central Station Steam Piping; Reorganization of Edison Interests; Grounding the Neutral Wire in Three Wire Systems. The presence of Mr. Edison is promised. An additional attraction is the great Industrial and Electrical Exposition, with its fine "Tower of Light" and other novel features. It is proposed to run a special sleeper from New York on Sunday, Sept. 14, at 9:50 a.m.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The Institute will hold its first meeting for the season of 1890-91 at its new headquarters, on Sept. 16, when Prof. F. B. Crocker will deliver an address on "The New Electrical Units," and will take up for discussion the general subject of electrical nomenclature. A report will also be presented from the Wiring Table Committee.

THE SIOUX CITY CORN PALACE.

The electrical exhibit at the Corn Palace is going to be one of the leading features this year. Many attractions have already been secured. Electricity will be furnished exhibitors from batteries or 100 or 500 volt constant potential lines, 50 volt alternating, or 10 ampere constant current.

The finest space on the ground floor has been assigned for the electrical display. Full information can be obtained from the Sioux City Electric Supply Co., Sioux City, Ia.

HAIR FELT IN DYNAMO ROOMS.

Hair felt placed in the foundations of the steam engines operating dynamo stations will, it is said, effectively remedy the noise and vibration now so often complained of where a station is operated in a private neighborhood. An electric company recently had one of its ninety h. p. engines removed from its foundations, which were then taken up to the depth of four feet. A layer of felt five inches thick was then placed on the foundations and run up two feet on all sides, and on the top of this the brick work was built up. The cost of the alterations was about $300.—*Safety Valve.*

CORRESPONDENCE.

CHICAGO.

The North Side Electric Road.—The Electric Fountain.—Signs for the Times.—Telephone Subscribers Kicking.—The Thwing Electric Co.—Electric Railway Work at Aurora, Ill.—Electric Light Consolidation at Joliet, Ill.—Electric Base Ball.

THE North Side Electric Road, which was incorporated very recently, is stated to be making steady progress. The promoters of the scheme are still confident that the construction work on the line will be begun this fall. C. H. Remy states that the entire $1,000,000 of stock has been subscribed, and that the road will undoubtedly be built as projected. The names of the subscribers have not been disclosed, but it is understood that they are Eastern capitalists.

The electric fountain at Lincoln Park was viewed last Saturday evening by large crowds and was pronounced a complete success, the highest commendation on the beautiful effects produced by means of electricity being bestowed from all sides. Numerous and beautiful changes were gone through and the display lasted for an hour.

The electric light poles at the street corners have now been furnished with signs having the names of the streets on them. One can now read his location beneath the cheery light of the arc lamp and journey peacefully along without finding he has taken the wrong street.

A number of aldermen have waited on the law department relative to the rights of the telephone company to charge additional toll for connections made with telephones by subscribers in the annexed districts. City subscribers pay $125 per annum for the use of telephones. The stock yards, Englewood and old city subscribers think that this additional toll is an injustice. President Stone, of the telephone company, called on Corporation Counsel Hutchinson in regard to the matter and informed the gentleman that Englewood and Lake were outside exchanges just as much as Joliet and Milwaukee were. Mr. Hutchinson will consider the matter.

The Thwing Electric Company is the name of a new concern recently incorporated, with a capital stock of $1,000,000, by Wilber J. Andrews, Charles B. Thwing and Charles E. Piper, to manufacture and deal in electric lamps and supplies. The new company will place on the market an incandescent lamp, the efficiency of which, it is claimed, has been demonstrated within the last three months to be remarkably high. The lamp was purchased last April by J. A. Munson & Co., of Evanston, and a number were placed in the hands of the National Engineering Bureau, of Chicago, to be tested for life durability and efficiency, with highly satisfactory results. The Thwing Electric Company is backed by a number of prominent Chicago and Kansas City capitalists, and a factory has been purchased. The company will shortly begin the manufacture of their new products.

Ground has been broken at Aurora for the new electric railway, and the company expects to have twelve miles of road in operation by December 1, and twenty miles within two years. The Edison system will be employed. The west side of the city, made up largely of retired farmers, is opposing the road, whilst the east and largest side are actively supporting it and circulating petitions for the road on their respective streets. The first trouble occurred in a dispute between M. R. Bruce and Alderman Caas, resulting in the arrest of the alderman for assault.

Articles of incorporation have been filed by the Economy Light and Power Company, of Joliet, Ill., a consolidation of the Thomson-Houston and Westinghouse companies. John L. Norton, of Lockport, is president; L. E. Ingalls, of Joliet, secretary, treasurer and manager, and J. C. McMullin, of Chicago, vice-president. The two companies have been fighting each other for the last year, and the Thomson-Houston Company took the city lighting from the Westinghouse.

An exciting contest took place at Jackson Park on Saturday last, at 2:30 p. m., between the Okonites and the Kerites. The Okonites are composed of the employés of the Central Electric Company, and the Kerites are those of the Western Electric Company. The score was 21 to 6 in favor of the Kerites, and throughout the game their megohm capacity was never lowered in the slightest. The victors claim that their success was entirely due to the high insulation resistance they maintained. They short-circuited the bases in remarkable style and no faults appeared, even under the high pressure current of the Okonites. The Okonites made a gallant struggle but were unsuccessful in their endeavors to ground their opponents. The specific inductive capacity of both sides for hits of high voltage was enormous, and some fine ball was witnessed by the numerous spectators, who said they had never seen a game so free from unnecessary retardation or prolongation.

CHICAGO, Sept. 5, 1890.

DR. G. STERN, of the staff of Ganz & Co., Buda-Pesth, is spending some days in New York, *en route* from Australia, where he has been engaged for some months on important work for his house.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.
Anonymous communications cannot be noticed.
The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.
In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.
Sketches and drawings for illustrations should be on separate pieces of paper.
All communications should be addressed EDITOR OF THE ELECTRICAL ENGINEER, *150 Broadway, New York city.*

FRANCISCO'S FALLACIES.

[137]—Were I asked the question "How can the National Electric Light Association best serve the interests of the central station companies?" I should unhesitatingly answer, "By withdrawing from circulation the pamphlets on municipal lighting which it proposes to send broadcast throughout the country," as it will open up the subject of the actual cost of producing an electrical horse power hour of energy to a fresh discussion in the daily papers, and will prove the opening wedge leading to the final bankruptcy of many of the small local lighting stations.

The thoughtful managers of local stations do not want this subject of municipal lighting agitated, for they are not making any too much money at the present time, and any discussion of lower prices for city lighting just previous to the renewal of their contracts cannot but result in financial loss to the companies.

Again, if every member of the town council is favored with a copy of the Francisco pamphlet the local manager probably cannot see how it will benefit the company, as he knows full well that the gentlemen (the "politicians," a la Francisco) who rule the little world in which he gravitates probably never heard of the N. E. L. A., or know aught of its power for good or for evil, and will be perfectly indifferent to any views the Association may give expression to unless in accord with their own ideas.

If the local "politicians" have set their heart on securing a municipal lighting plant as a stepping stone to a re-election, are they going to be swerved from their line of action because an association of interested agents says that municipal lighting is neither economical nor in the line of liberal public policy?

And if the local manager attempts to combat their arguments by reading extracts from the Francisco pamphlet, can the council not easily secure the services of an expert representative of a parent company having no interest in the local plant to work out every detail in the preparation of plans and specifications so skillfully drawn that they will show conclusively to the poor deluded taxpayer that his interests are best served by installing a municipal lighting plant that will afford a greater amount of illumination at a less rate than the local company ask?

If you doubt that any parent company would sanction such action on the part of their representative, read the following extract from Judge Armstrong's report to the National Electric Light Association:

"Capital has been induced in spite of its proverbial timidity to invest in what has been an unexplored field. Often this investment has been brought about by the parent companies themselves. Then when it has seemed as if the stormy days of doubtful experiments were about over, and there was some little possibility that this investment might begin to make returns, along comes the agent of some parent company and by specious representation induces other citizens of the same place to start a new plant, always forgetting to tell of the weary journey of the pioneer company, and pointing always to present position. The only province of this new plant is to damage and destroy what did give some promise of life and fruit, and incidentally to make a market for a little new apparatus, effectually closing, however, a profitable avenue of steady continuing business in sales to the original companies.

"It is rumored very strongly, and, indeed, stated as a fact, as strange as it may seem, that parent companies, not satisfied with permitting, have gone so far as to organize central station companies in competition with others which are abundantly able to supply all demand, strengthening, supporting and sustaining them in their unholy warfare against legitimate enterprise."

And should the local manager appear to have the best of the discussion and the expert agent is anxious to effect a sale of his apparatus, how quietly he will call the attention of the council to the absence of all figures relating to the operation of municipal plants in four other cities where the results obtained are more favorable to his side of the question. And can you blame him if he pilot the council or its committee to points like St. Louis or Cincinnati where arc lights of nominal 2,000 candle-power are furnished for less than 'the average price?'"

And in the latter event, will the Francisco pamphlet cause the "politicians," bent only on accomplishing their aims, to consider whether the large out-put of the St. Louis plant is the prime factor in the low price afforded; or that the Hickenlooper station and circuits in Cincinnati were built by Mr. Card solely with the view of securing the highest commercial results with the least expenditure for maintenance? Will the "politicians" consider these im-

portant factors, or will they conclude that if a private company can supply light at less than "the average price" probably their city can do as well?

During the discussion of the Francisco paper Mr. George S. Bowen, the honored father of the Association, said: "Prof. Barrett enjoys the confidence of every man in Chicago, whether he is a Democrat or a Republican. They all refer to him as an absolute authority. * * * I congratulate him and I congratulate the city, because he is a man of great capacity as an electrician, and is an honest and square man. That is the kind of a man we want to run our electric lights."

Now, suppose for the moment that the committee that are coming to Chicago to investigate the cost of lighting our streets should find that the statements contained in the Francisco pamphlet are not in accordance with the facts as shown by the records, and that the lighting of the streets in Chicago is being secured at a fair cost.

Would the circulation of the report be of material value in advancing the interests of the local lighting stations in the smaller towns? And, further, suppose that the press of the city of Chicago, feeling that one of their honored citizens, Mr. J. P. Barrett, had not been treated fairly in this matter, should give great prominence to the report of the committee, would the local lighting stations derive any financial benefit from such action?

I do not believe in the economy of municipal lighting. I never believed in it. And with one exception I have refrained from giving any prominence to the subject. Nevertheless, municipal lighting will always be with us in some form. It is a necessary evil that we will have to contend with just as long as personal feeling is allowed to overrule public welfare. *Then why bother with it?*

Let me call your attention to one more point and then I will close. There is another side to this pamphlet. How will certain statements contained therein affect the proposed investment of capital? The capitalist is the best friend the electric lighting industry has. Will he be so likely to invest in local lighting plants if he finds his daily paper harping on the question of the economy of municipal lighting? Or if he dreams that ill-advised legislation or bitter competition may reduce the prospective income of the projected plant?

And the agent—that living embodiment of enterprise and energy—the representative of the parent company? When he finds that he may be compelled to "make his bricks without straw," will he feel like including Mr. Francisco in his mighty petitions for the blessings of heaven when he reads the following lines in the pamphlet that was distributed at Cape May and which has been published in many papers?

"Judging the future by the past, with the mighty strides that have been made in electrical inventions, two years from now the entire apparatus at present owned by municipalities may be consigned to the scrap pile and necessitate a new outfit costing thousands of dollars. What is to done in this case? Electric light companies have already had this experience, and I can cite a case where the company paid $4,500 for their dynamos, and after a little over two years, could only realize $300 from these same machines." Will the agent wonder why an association that had been publicly cautioned not to make *any mistakes* should have been induced to indorse and stamp with its approval a statement from which the inference can easily be drawn that electrical machinery must be replaced every two years to secure the best results?

Was not the lot of the agent hard enough before without adding this burden? Has he not been telling his customers that the apparatus sent out by the electrical manufacturing companies is so perfect mechanically and electrically that plants installed eight and ten years ago are giving good satisfaction to this day? That he can show armatures that have been in constant operation for years without the expenditure of a dollar for repairs? That an investment in an electric lighting plant was a safe and legitimate investment, and that an allowance of ten per centum per annum was amply sufficient to cover all depreciation?

These statements have been the agent's stock in trade. How will they be affected now that the Association which his company has helped to build up is going to hurl broadcast the statement that "two years from now the entire apparatus owned by municipalities may be consigned to the scrap pile?" In other words, a yearly depreciation of fifty per cent. must be allowed for when figuring on an investment for electrical machinery.

And not a delegate challenged this statement. The municipality of Chicago own the apparatus sold to them by the Thomson-Houston, the Brush, the Western Electric, the Edison, and other companies. Does any one honestly believe it will be in the scrap pile two years hence?

But if these makes of apparatus are going into the scrap pile, why should capital not hold aloof for two years and then purchase the "new outfit?"

In conclusion, what remains to be done? Where is the central station to seek relief? Dare it confide in the parent company after the plain-spoken report of Judge Armstrong? I believe there is but one of two methods of procedure left open to the central station, if it would not be driven to the wall: Either to join the National Electric Light Association and have a delegate present at every meeting to fight for self-preservation, or else to form a new association to be composed only of superintendent or managing officials not in any way connected with any parent or manufacturing company, and then unite in frustrating such action as will favor present unholy warfare against legitimate enterprise.

CHICAGO. FRED. DE LAND.

ELECTRICAL NOMENCLATURE.

[138.] The letter of Dr. J. A. Fleming in your issue of August 20th shows that my proposal to give the name of Henry to the practical unit of self-induction has reached the other side of the Atlantic and is favorably received there—which is very encouraging.

I cannot say, however, that I like Dr. Fleming's abbreviation—the "hen"—and I was surprised to see that your editorial of Aug. 27th apparently approved of this clipped bird. I think that the form *hen* would be undesirable for several reasons. It destroys the identity of the name; the word already has another meaning, whereas "henry" is distinguished from the proper name by the absence of the capital letter; the idea suggested is too much "from the sublime to the ridiculous," and, moreover, a word of only five letters does not need abbreviation. The name henry is shorter than ampere or coulomb, and is as short as farad which is already cut down. I by no means favor long names, and I believe in avoiding them wherever possible, but "henry" is a short name and certainly it is not necessary for electrical terms to be written like "Sanford and Merton," in words of one syllable only.

In regard to the other units and names suggested by Dr. Fleming, I think they are well chosen, and the short forms *frank* and *gilb* are in this case more necessary on account of the length of the names Franklin and Gilbert, and they are also less objectionable when shortened.

FRANCIS B. CROCKER.

COLUMBIA COLLEGE, SEPT. 4, 1890.

REPORTS OF COMPANIES.

STOCKS AND BONDS.

BROOKLYN, N. Y.—The Edison Electric Illuminating Company's stockholders met at 362 Pearl street, Brooklyn, on Sept. 4, and increased the capital stock from $600,000 to $1,500,000 in order to extend the business of the company. The following gentlemen, representing $400,000 of the $600,000 worth of stock were present: Charles E. Crowell, Ethan Allan Doty, Edwin Packard, Jesse Johnson, and William Richardson. The latter voted against the increase.

NEW YORK CITY.—The East River Electric Light Company, New York City, has mortgaged its rights and franchises to the Holland Trust Company for $600,000. In 1885, when it was organized, it mortgaged its effects to the same company for $300,000. Under the assignment the original loan is taken up, and the company gets the $300,000 additional for its immediate use. The East River Company has not extended its wires through the subways over the extent of territory which its overhead wires occupied. With this $300,000 its officers say it will make all necessary extensions and enlarge its plant at 425 East Twenty-fourth street.

NEW YORK CITY.—The consent of a majority of the shareholders of the United Electric Light and Power Company to a mortgage not to exceed $5,000,000 has been filed in the County Clerk's office.

METAL AND SUPPLY MARKET.

HIGHER PRICES FOR RUBBER.

The Gutta Percha Rubber Manufacturing Association held its quarterly meeting last week in this city, and adopted the following resolution:

Resolved, That it is the sense of this meeting that, in view of the high prices of crude rubber, a further advance should be made in the prices of manufactured goods.

A. Spadone, the president, said that the resolution simply reaffirmed the advance of 10 per cent. on rubber goods made at the last meeting. Prices of crude rubber had advanced 5 per cent. within the past three weeks, and some kinds of rubber were very scarce. While the output of rubber in Brazil was as large this year as formerly, the demand had increased enormously in this country and in Europe, especially for the purposes of insulating electric wires. There would not be another rise in prices of manufactured rubber for at least one month, as prices of crude rubber might possibly go down.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

ALEXANDER, BARNEY & CHAPIN.

ONE of the most interesting and remarkable features of recent electrical development has been the springing up of large supply houses in various parts of the country. The rapid growth of half a dozen new industries, each rivaling if not excelling the telegraph and telephone in importance, has, in fact, necessitated the creation of these agencies for handling and distributing an enormous variety of staple goods, specialties, novelties and minor products; and the result is to-day that such concerns do a business that mounts up into the millions of dollars and bids fair to assume proportions of colossal magnitude. These supply houses are one of the best indications that could be asked for of the breadth and stability of the great electrical industries of to-day, and their prosperity must necessarily increase, *pari passu*, with the ripening to maturity and passing into common use of a score of inventions and devices that are yet crude but are destined to become things of everyday familiarity to the public, besides being also a direct stimulus to the production of hundreds of big and little appliances and details that must be forthcoming before perfection of service and economy in operation can be attained. Moreover, not a single department in the older applications of electricity has yet had all its needs met adequately, and the restless spirit of American invention every day proposes some new improvement or refinement requiring new apparatus and novel lines of supplies.

The tendency above referred to in the field of electrical supplies first showed itself, as might be expected, in the West, not only in Chicago, but in other large cities with their own territory to look after and cater to. It was only a question of time, however, when even in New York City new houses should come to the front and make a bold bid for recognition and patronage in competition with concerns that have long been known throughout the country; and now is seen the establishment here of a firm that is determined to make the strongest kind of running and to build up a great business in a very short time. We refer to the firm of Alexander, Barney & Chapin, or, as they have been playfully dubbed by a friend, "the new A. B. C. of electricity."

The members of this firm are so well known that even a brief outline of their careers will be seen to embrace most of the later industrial developments of electricity. The formation of the firm thus becomes an electrical event of the first importance. Mr. P. H. Alexander, who has been up to the present time the general manager of the Sawyer-Man Co., has been engaged in the electrical field from the early days. No small part of the central station work done by the Thomson-Houston, Sawyer-Man and Westinghouse companies in New England during the past five or six years has been worked up and carried out by him. As a reward and consequence of his efforts he was invited to take the position of general manager of the Sawyer-Man Co., and the really phenomenal success of that company's lamp business attests his able and brilliant direction, both as an executive officer and as a salesman. Probably no electrical man in a similar capacity in this country has drawn so large a salary as he. Outside of his business interests Mr. Alexander has shown himself public spirited in a most praiseworthy manner. As president of the New England Electric Exchange he has devoted much time to the harmonizing of the electrical and insurance interests in New England. The rules and regulations laid down have been of great benefit throughout the country. The standard of work and efficiency has been raised, and the good is lasting. Mr. Alexander is now a member of the National Electric Insurance Bureau, who are framing rules for the installation of plants all over the United States. It is almost superfluous to add that he is well fitted to be head of the new firm. He is a man of strong personality, whose opinions and influence are deeply felt, and a host of friends will greet his enterprise with approbation and active support.

General C. H. Barney is a telephone pioneer and known to everybody as the secretary of the National Telephone Exchange Association, which meets this week in Detroit. He began in the telephone business in 1879, resigning for that purpose his position as treasurer of the Providence Gas Burner Co., with which he had been connected for ten years. After two years' experience in Providence and Boston, during which time he constructed the first long-distance telephone line between those cities, in December, 1881, he was called to the management of the New Jersey Telephone Company, which position he held until his resignation in 1886, at the organization of the Sawyer-Man Electric Co., of which he is now the treasurer. He was one of the charter members of the New York Electric Club, and is a member of its Board of Managers. As treasurer, too, of the Sawyer-Man Co. he has had the management of large financial interests, and takes with him knowledge and experience that will be invaluable. He has been honored by the State of New Jersey with various official appointments, and has the widest possible circle of acquaintance.

The third member of the firm, Mr. Charles E. Chapin, who has been the purchasing agent of the Sawyer-Man Co., and becomes buyer of the new concern, entered the electrical field some years ago as the secretary of the Waterhouse Electric and Manufacturing Company, of Hartford, Conn. On the sale of the company to the Westinghouse Electric Company, Mr. Chapin went to Pittsburgh and was thence transferred to New York. The rapid extension of the Sawyer-Man business, both in respect to the supplies furnished to central stations and the needs without end of a large factory, has demanded great activity in the purchasing department, and Mr. Chapin has demonstrated his quality very strikingly.

The crystallization of certain industries around definite localities has already become marked in New York, and the clustering of the electrical professions and trades, in a district of which Cortlandt and Dey streets are the centre, is one of the features of the time. Perhaps the very core of this district is the handsome Telephone Building, 16, 18 & 20 Cortlandt street, which is literally an electrical hive, and it now promises more than ever to become electrical headquarters, for the reason that Alexander, Barney & Chapin will there open a large store. They have leased the street floor on the left of the main entrance, and hope, by October 1, to throw open its hospitable doors to the electrical public. It will be very elegantly fitted up, and nothing will be spared for the comfort and convenience of visitors. The firm will represent leading manufacturers in goods adapted to the electrical trade, and will keep in stock as well a line of general electrical supplies. Of some of their arrangements in this line occasion will offer presently for extended mention. In representing inventors and manufacturers the new firm from their long experience and wide acquaintance are particularly able to place goods in the channels of largest consumption. Among some of the many novelties they will at once proceed to introduce, may be named the ingenious mercury cut-out lately patented by Mr. S. D. Field, the beauty of which is that it at once recovers itself and restores the circuit to its normal condition after answering its aim as a protector for delicate instruments against "tramp" and "freak" currents. Another specialty is the attractive new insulating material, "Alexite," lately exhibited at Cape May. This material will be under the control of Alexander, Barney & Chapin. It can be made into any shape, and has the properties required for cut-outs, switches, etc., being fireproof, waterproof and acid proof. Any color of wood, paper or marble is closely imitated, so that artistic harmony with furniture, tapestries and the like, in the details of interior wiring, can be easily attained by its use.

The firm are also bringing out a new line of switches for interior electric light work, embodying valuable improvements, and these will be placed upon the market at a very early date, with a number of other things that will be touched upon in these columns from time to time as they appear. Altogether the plans of the firm have been very shrewdly and broadly laid, and the prediction may be made that their entrance upon the field will make a historic date in the electrical supply business of New York.

A NEW MANUFACTURING ENTERPRISE.

There were filed in the Ohio Secretary of State's office last week, says the Cincinnati *Commercial Gazette*, of August 17, articles of incorporation for an enterprise that bids fair to be one of the leading industries of this city and the largest of its kind in the United States. The title of the new company is The John B. Morris Foundry Company, and it is capitalized at $100,000, and officered by the following gentlemen: John B. Morris, president; Henry J. Grossius, secretary; S. L. Miner, treasurer; J. G. Niehaus and W. H. Edwards being the other two of the five directors. They are at present doing business where John B. Morris has been so successful, in the old well known Greenwood Foundry, corner Canal and Jackson streets.

The new concern, realizing that their present site is entirely too small and incommodious, have secured property at the corner of Court and Harriet streets, on which they will erect a fine commodious four-story brick building, which will be adapted to the immense business they propose to do, and it will be completed and ready for business about January 1, 1891. Their manufactures will comprise stove and furnace repairs of all kinds, machinery castings, plumbers' goods, hardware and electrical specialties, etc.

The well known business experience of the gentlemen connected with this company insures its permanent success.

NEW ENGLAND PRINTING TELEGRAPH CO.

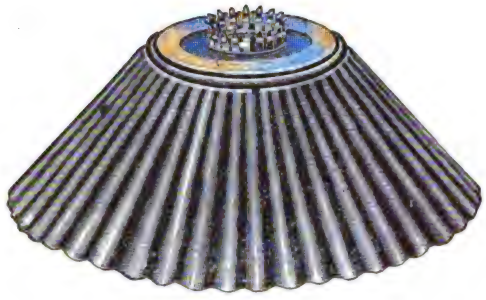
The annual meeting of the New England Printing Telegraph Company was held at the executive office of the company, 113 Devonshire street, Boston, last week. The following board of directors were elected:

Frank B. Dole, Boston; John R. Reed, Westfield; P. S. Jennings, New York; Abner McKinley, New York; James P. Cook, Boston; George W. Slade, Fall River; Maybin W. Brown, Boston. Frank B. Dole was elected president; R. H. Waters, treasurer; H. B. Humphrey, secretary; Maybin W. Brown, general manager; C. F. Hutchinson, general superintendent; executive committee, F. B. Dole, Abner McKinley, James P. Cook, George W. Slade.

A NOVEL LAMP GUARD.

A wide-awake Michigan foundryman has found a new use for lamp shades, at least when made of tin in a conical form. After trying various forms of lamp guards to protect the incandescent lamps used by the workmen in lighting the moulds, he finds the Cutter combination cone shade to give the best protection.

It is easily seen from our illustration that this shade will throw the light just where it is needed, and that when set flat on the ground it completely covers the lamp and shields it from acciden-



A Novel Lamp Guard.

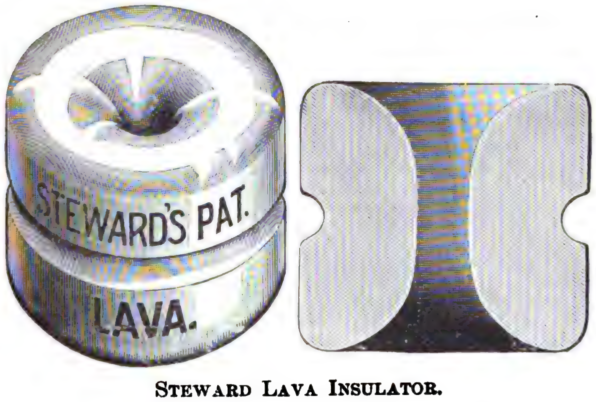
tal dropping of tools. There are many other workshops where these same qualities will be appreciated, and where the combination of a shade-holder, shade and lamp guard in one piece will make incandescent lighting still more practicable.

A FEW ENDORSEMENTS OF THE INTERIOR CONDUIT SYSTEM.

This interesting sheaf of testimonials from a large number of men, including bankers, architects, electrical engineers, insurance inspectors, underwriters, wiring contractors, electric light superintendents, and others, is a striking evidence of the extraordinary hold that the idea of wiring buildings with the help of interior conduits has taken upon the public mind. A number of the documents, such as the letters from Pierpont Morgan, T. A. Edison, and Elihu Thomson, are given in fac simile, and constitute a body of favorable evidence that the Interior Conduit and Insulation Co. does well to give the utmost publicity to. An interesting part of this pamphlet is that embracing the extracts from insurance rules which name and authorize interior conduits.

LAVA INSULATORS.

We illustrate in the accompanying engravings the lava insulator manufactured by the D. M. Steward Manufacturing Co., of Chattanooga, Tenn. The material of which these insulators is made possesses the valuable properties that it is not only a perfect insulator, but in addition is thoroughly fireproof, so that high



Steward Lava Insulator.

tension circuits can be attached to them with safety. The lava is exceedingly strong and can be molded into all conceivable shapes, whether for electric light or railway work. These insulators have come into extensive use and have in every way given the best satisfaction.

WOODHOUSE & RAWSON.

A silver medal has been awarded to Woodhouse & Rawson United Limited, of London, for their show at the Exhibition of Fire and Life Saving Apparatus now being held at Amsterdam, Holland.

THE POND STEAM SEPARATOR.

It is a well established fact that steam when being conveyed to an engine contains a large percentage of water, resulting from entrainment of water from the boiler during rapid evaporation, and condensation in the pipe connections between the boiler and engine. Water conveyed by the steam to an engine, not only represents a large percentage of loss, but also introduces an element of danger, especially to the high speed engines of the present day, in which clearances are reduced to a minimum.

The Pond separator, built by the Pond Engineering Co., of St. Louis, is so placed in the line of pipe near the engine that all the steam conveyed to the engine must pass through it. It consists of an outer cylindrical shell into which the steam enters with the entrained water, and leaves through an inner pipe extending from the top down to about one-half the length of the separator, by which arrangement an annular space is left between the two.

Pond Steam Separator.

The lower part of the separator is enlarged and forms a receiver of sufficient capacity to provide for any sudden flow of water from the boiler. An opening of proper size is provided at the bottom for removing the water, and a glass water gauge is supplied to show the level of the water at all times in the separator. A flange connection is made between the upper and lower part of the separator, so that it can be easily opened for inspection, without breaking any joints in the line of pipe. The Pond separator is guaranteed to relieve the steam of all entrained water and return this water to the boiler, either direct or by means of a trap, as the location of the separator may determine.

The Great Western Electric Supply Co.—Judging from the popularity of the Cutter E. L. Insulator, the blackening of ceilings by arc light wires should be less frequently met with than heretofore. The reason is quite plain, as there seems to be no practical way of avoiding the blackening when the ordinary porcelain insulators are used. But as this unsightly effect decreases rapidly as the distance between the wires and the ceilings becomes greater, the design of this insulator has practically solved the difficulty. One would not be surprised if the saving in the kalsominers' bills would entirely pay for the insulators where Cutter's E. L. form is used.

ELECTRIC LIGHTS IN SPANISH AMERICA.

The element of progress which has made itself manifest in the West Indies recently, a subject which not long ago was made the occasion of an oration by United States Representative Douglas, is especially notable in Havana, Cuba. As an incontestable proof of this fact, it is only necessary to cite the growth of the electric light industry in the island of Cuba.

About two years ago a number of prominent capitalists of Havana organized the Spanish-American Light and Power Company with the intention of establishing a small electric light plant for their own immediate use. A representative of this company was sent to the United States to examine the different systems of electric lighting. After investigation, a decision was made in favor of the Westinghouse alternating current system. Westinghouse apparatus, consisting of two 750 light alternate current dynamos, was at once installed at the company's central station in Havana, and the operation of the plant was hurried as quickly as possible. But even before all the wiring had been completed, the Havanese became convinced of the great boon afforded them by a general introduction of the novel system of illumination. The result was that the Westinghouse Company received a telegraphic communication asking whether it were possible to ship at once by express alternating current apparatus, exciters, switches, etc., for a capacity of three thousand incandescent lights. The Westinghouse people at once replied that, in the way of supplying electric lighting apparatus, they were always able to fill any and all orders at a moment's notice. The following day the entire plant, an express package of many thousand pounds, was shipped to Havana, and immediately upon the arrival the plant was put up, giving the company a lighting capacity of 4,500 incandescent lights. Since then the company has been doing a very profitable business, and electric lighting has constantly increased in popularity. The demand has steadily grown until it has now again become larger than the company is able to supply, and again enlargements have to be made.

The Westinghouse Electric and Manufacturing Company is now preparing for early shipment an increase of alternating current apparatus for 1,500 lights. This will give the central station in Havana a capacity of 6,000 lights.

NEW ENGLAND TRADE NOTES.

MR. HENRY A. REED, secretary and manager of the Bishop Gutta Percha Company, was in Boston for a few days this week looking up his numerous friends, who were all glad to see him, as he does not frequently get down in this section.

H. E. SWIFT MANUFACTURING Co. is the name of the new incorporated company which will succeed to the business of H. E. Swift & Co., with headquarters at 34 Oliver street, Boston. The company has been capitalized for $50,000, and the following are the officers:—H. E. Swift, president; J. A. Andrews, Jr., vice-president; W. L. Boyden, treasurer; and T. P. Swift, secretary. Their business is rapidly increasing, and they are already finding their new quarters somewhat small for the work they are doing, and are making preparations for the occupancy of another floor.

THE CONNECTICUT MOTOR COMPANY, of Plantsville, Conn., have recently made an addition to their personnel, in the appointment of Mr. F. O. Rusling, formerly with the Thomson-Houston Electric Company, as special agent. Mr. Rusling will have sole charge of the sales, and with a good motor behind him, will carry on the business of the company with his wonted energy and zeal. The Connecticut Motor Company recently increased their capital stock, and this fall will largely increase their facilities for manufacture, as their business is rapidly increasing, their sales for the month of August being the largest for any month during this year. The Connecticut motor only requires good business push to make it rank with the foremost, as it has proved very satisfactory wherever used. The U. S. Government are using quite a number, and are well pleased with their efficiency.

THE ROBINSON RADIAL CAR CO., of Boston, have perfected arrangements whereby they can manufacture trucks in large quantities, and are now receiving orders from all parts of the country. The new car which they shipped this week to the Eckington and Soldiers' Home Railway, Washington, D. C., was a thing of beauty, and the most elegant, capacious, and attractive car ever seen in that city. It is 35 feet long, with a 14 feet wheel base, fitted with the standard steel radial truck. The design is entirely new, the car having a sweeping arch roof, as seen in the latest type of steam cars, with a monitor top, not visible from the inside of the car, thereby procuring a perfect system of ventilation without any draught, and retaining the beauty of the car inside. The car is finished in rich mahogany and the ceiling is panelled with gold. The Robinson Radial Car Co. are building 14 cars for the West End Street Railway Company, to be ready this fall, and expect before this winter to have 50 electric cars running on various roads in this country.

WESTERN TRADE NOTES.

MR. JAS. LOUNSBURY, one of the managing engineers of the National Engineering Bureau, of Chicago, has returned from a trip, looking well and ready for work. The bureau makes a specialty of testing, supervising and furnishing specifications and plans of all kinds of electrical and mechanical power work.

MR. FOREE BAIN has just returned from St. Louis, where he has been for the past few days designing the electric fountain and also the electric kaleidoscope and cataract for the forthcoming exposition there. He has now gone to Iowa on a short trip to start up his new 100 horse-power generator in the coal mines there.

THE ANGLO-AMERICAN STORAGE BATTERY CO. are making a new departure in storage cells, and introducing a small battery from 3 to 5 inches in height for bell and annunciator work. It is claimed for these new cells that they give no trouble, are very certain in their operation, and that one charge lasts a very long time on the above class of work.

EDDY PLATING MACHINES.—The electroplating machine recently sold by Mr. G. A. Edward Kohler, the Western representative of the Eddy Electric Motor Company, to Rand & McNally, was one of the largest sizes built by the company, and capable of depositing 25 pounds of copper per hour. The machine is being used for electrotyping purposes.

MR. G. T. HEWES, the prominent traveling representative of the Great Western Electric Supply Company, of 190–192 Fifth Ave., Chicago, has returned to the city for a short stay from an extended and highly satisfactory business trip. He was received everywhere with enthusiasm, and his reception culminated in numerous large orders, showing the appreciation with which the large new enterprise engineered by its able manager, Mr. Geo. Cutter, is being everywhere received. Mr. Hewes leaves immediately for St. Louis, where he will be found at the Exposition, loaded with samples and happy to explain the merits of his company's many new specialties.

THE ELECTRIC MERCHANDISE COMPANY have just issued to their patrons a very attractive catalogue of their electric railway supplies, to the manufacture and sale of which they devote their exclusive attention, being the sole company so doing in the country. Their supplies are made for all systems. The catalogue contains some 70 pages of printed matter, handsomely and extensively illustrated with fine cuts, describing their numerous specialties:—Measuring instruments, testing apparatus, lightning arresters, switches, connectors, lamps and lamp material, insulated wire and tape, trolleys, street car mats, heaters, interior conduits for car wiring, poles, line material and brackets, tools, etc. All receive careful attention and their methods of use and operation are thoroughly explained. This book furnishes a very handy volume of reference for street railway men and others, showing them at a glance the remarkable strides and improvements that have been made in this line, and intimating where they can get all the latest supplies of high quality and good workmanship for their railway work.

THE GREAT WESTERN ELECTRIC SUPPLY COMPANY, 190–192 5th avenue, have brought out a very fine catalogue of their electric supplies which are in such large demand all over the country. They term the book a "Sketch Catalogue," and it is to be immediately followed by one of mammoth proportions in accordance with the size and scope of Mr. Geo. Cutter's supply house. The name certainly applies in one respect, for the catalogue is filled with excellent sketches and cuts from beginning to end, while the descriptive matter is very comprehensive and full of information. Mr. Geo. Cutter, the manager, starts off with a contradiction of any reports stated to have been circulated by competitors that his present company is owned and controlled by the company with which he was so long connected, and says, "We are in the business to sell the best of supplies to all without impartiality." All classes of electrical supplies for telegraph, telephone, electric light and power use are shown, and many new specialties of decided merit are included. A careful perusal will repay the reader, as he will find much that is new, and goods which will adequately meet all his wants. The catalogue is printed in clear type on handsome paper, bound in a tasteful cover, and is altogether very neat and striking.

NEW WESTINGHOUSE PLANTS.

The San Antonio Gas Company, of San Antonio, Texas, appears to be well satisfied with the working of the Westinghouse alternate current incandescent system. It has at present in operation Westinghouse apparatus to a capacity of fifteen hundred lights and is just placing an order for a seven hundred and fifty light increase.

The Philadelphia market house is to be illuminated by the Westinghouse alternate current arc lighting system in the near future. The Westinghouse Company has sold the city officials a forty light plant for use in the market house.

THE
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New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.
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EDITORIAL ANNOUNCEMENTS

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers*

VOL. X. NEW YORK, SEPTEMBER 17, 1890. No. 124

Truth is of all value in itself, simply because it IS truth; irrespective of any practical application it may contain.—Alfred M. Mayer.

THE VALUE OF PIPE CLAY AND RED TAPE.

EMPEROR William, by recent warrant, has ordered that the ladies of the administration of posts, telegraphs and telephones shall be clad in a special uniform, to consist of a knitted blue jersey, with orange yellow collar, metal buttons and ornaments that presumably will correspond with rank. This regulation is, after all, but another expression of the tendency in Germany towards a military and official organization not only of the civil service but of society as a whole, and which will probably remain unsatisfied until even the beggars are covered with rags of a certain age and hue. What the energetic young emperor will do in a world where pipe clay, red tape and official uniforms are unknown, it is impossible to imagine.

By a somewhat interesting coincidence, the publication of this knitted blue jersey edict is closely followed up in a serious suggestion made at the Detroit telephone convention last week, in the paper of Mr. W. R. Patterson, to the effect that the time might be near at hand when the young ladies who constitute the staff in exchange operating rooms will be restricted as to the stuffs of which their dresses are made. But the reason that Mr. Patterson gives for a movement in this direction shows wherein the spirit of American discipline, which exists only for utilitarian ends, differentiates from that of bureaucratic Germany. It is hardly likely that the wearing of a knitted blue jersey, with an orange collar and metal trimmings, can help the German lasses to send more words per minute telegraphically, or will conduce to the greater rapidity of telephonic connections. But Mr. Patterson has a soul above buttons, and the pith of his recommendation lies in the fact that some fabrics for gowns give off more fluff and dust than others; and hence he would prefer the wearing of only such materials as would aid in keeping the switch-boards clean. We do not know but that it may be worth the while of the telephone exchanges, as a genuine feature of economy, and after the style of some leading modistes, to provide handsome super calendered finish dresses for the operators, to be worn only during office hours.

It was not alone from Mr. Patterson, however, that suggestions of a bureaucratic nature came, and we are furnished with another example of the superior spirit of American ideas, as to matters of discipline, in the admirable paper read by Mr. E. J. Hall, Jr. In the graphic and faithful sketch of this country presented by Prof. James Bryce in his "American Commonwealth," stress is laid upon the individualism and, contradictory as the qualities may seem, the "aptness for organization" of the people. Mr. Hall's paper and the principles it evolves strike us as a masterly grasping of this truth, and as a skilful plan to avail of all the value and benefit that can come from the sense of individual responsibility and the strength of co-operative aggregation. We Americans have been a little too fearful of organization, and have thought too often that system was a thing for slaves. But it is only by thorough, well designed organization that the best results can be obtained to-day from the huge masses of men and money that are a distinctive feature of our civilization. In truth, while our Government not seldom shows the evils of a disorganization resulting from the prominence in politics and office of raw, untrained persons with pet names, our industrial achievements are largely due to the working out by men who hold themselves and others well in hand, of schemes of discipline and methods of subdivision of labor that are simply perfection itself.

Many improvements seen in the telephonic field have been, and always will be, brought about by individual effort. There is no need to fear any lack of individualism, and Mr. Hall, whose own quiet personal influence is a steady factor for good, has done a public service in thus insisting on the importance of organization. It is but a few weeks ago that we had an opportunity of inspecting the plan of departmental reorganization drawn up for one of the largest electrical companies in the world, and it embodied evidence of a farsighted regard for the principles that Mr. Hall has now, in another sphere of work, so ably, so carefully, and so thoroughly enunciated. The subject and its treatment may be earnestly commended to the thought of all who are heavily burdened with the responsibilities of office or as employers of large bodies of men.

TELEPHONE "TROUBLES."

As in past years, one of the most prolific sources of discussion at the late telephone convention was the "troubles" experienced on switchboards and the apparatus connected therewith. The paper by Mr. George J. Davison which gave rise to it this year brought out again in prominent relief the numerous points at which switchboard apparatus is found to give out. When we stop to consider the extent to which an apparatus of this kind is used day and night, it is not surprising that defects are developed. The materials at our command in the construction of such boards are limited in number, and the question is one

largely of the best means of adapting it to the purposes intended. With the concentration of parts, which necessarily entails reduction in size, required on switchboards intended to accomodate thousands of subscribers, it might be expected that the difficulties would rather increase than decrease. Improved construction, however, has led to the opposite results, but enough failures still occur to make it apparent that we have not yet reached the end in this respect. It is evident that to a large extent brass as a contact metal in telephone exchanges has seen its best days, and that other metals must be employed to obtain the desired results. German silver has already found considerable employment and platinum has to some extent been used. The expense involved in the use of the platinum, however, must to a large extent bar this metal from use, but attention has lately been given to the application of aluminum for this purpose, and the results to be expected from it are certainly encouraging. Its application in the new Law board employed in Philadelphia will be looked forward to with considerable interest. Opinions among the members of the convention seemed to favor the employment of the double cord over the single cord, on account, no doubt, of the ease with which troubles due to them can be remedied. The urgent necessity of securing the greatest cleanliness and freedom from dust in exchanges is prominently brought out by the frequent annoyances arising from "dirty contacts." Indeed, all the troubles now experienced go to show that in telephony not less than in electric lighting good engineering is an essential quality of success to be attained in operation. Nowhere probably has this been realized to a greater extent than in this city, and the results already obtained are evidence of the correctness of the principles followed.

STRUCTURAL LIGHTING EFFECTS.

The flexibility of the electric light as a method of illumination long ago was illustrated by novel effects in chandeliers and candelabra. Then it invited to spectacular display in projections and in iridescent fountains. Latterly it has scored new triumphs in towers of light, and we are able this week to lay before our readers full illustrations and details of the tower that is delighting the good folk of Minneapolis. This tower, which owes its success to the refined taste and engineering skill of Mr. Luther Stieringer, marks a most decided advance in structural lighting effects, and must lead to the general introduction and use of the miniature incandescent lamp for schemes of interior decoration and illumination that have not been entertained as practical up to date.

Evidently there is a wide application for lights that have no "wrong side up," but will burn in any position and at any angle. Lines of light may now be as graceful and fluent as those of drapery. The architect and artist may design and execute free from conditions that have long been arbitrary and binding. They may mold their light or accentuate with it just as they would with masonry or color; they could not ask for decorative material more plastic, responsive or submissive. And while this is true of the ordinary incandescent lamp, it is specially the merit of the miniature lamp, which is still much more of a novelty than it ought to be. A moment's thought on the opportunities for emergency lighting, the chances in summer gardens and winter ballrooms, the desire for something out of the common at festivities and public gatherings, the delight of everybody in spectacles, and the particular favor shown towards chromatic and pyrotechnic displays—a moment's thought, we say, will show that here is work which would be at once pleasant and profitable. Why should not central stations give a little time to it? Let them see what can be done the coming season.

ELECTRIC CAR GEAR.

Those who have studied the application of the electric motor to railway purposes cannot have failed to be impressed with the attention which has of late been given to the connection of the motor with the car axle. The first devices employed were naturally those which had been used in mechanics for a long time, and they have accomplished their purpose in an eminently successful degree; but, as time passes and experience is gained with their use, it is evident that improvements can be made, and it is upon these that not a few of our most prominent inventors are at work at the present time.

Our current issue brings this out in a description given elsewhere of two forms of car gearing, both of which embody original methods. Mr. Edison has worked out a method in which, by the employment of two motors, he is able to so connect them, that in so far as their driving power is concerned, they may be used either in conjunction or differentially, so as to propel the car at different speeds, one acting then as a dynamo, and the other as a motor. The arrangement also permits of the motors being operated continuously, whether the car is moving or not, and thus overcomes the objection which is raised against the heavy draught of current required to start electric cars.

Mr. E. H. Johnson, to whom the electric railway in America owes so much, has also attacked the question in an original way, with the problem set before him of permitting the motor to obtain practically its normal counter-electromotive force before taking up the load, so that the initial current taken by the motor on the closing of the circuit, even when starting from a standstill, is practically no greater than the normal working current. He has also introduced an ingenious device by which any variation in load, whether an increase or decrease, is taken up by the motor without shock, and with the same economical use of the current. He accomplishes this by the introduction of a spring arrangement in connection with the armature, which determines the power-transmitting value of the motor, and which forms the intermediary between the armature shaft and the driven axle.

Although cable manufacturing and cable laying for ocean work has not yet become one of the standard industries of America, the aggregate amount of electric cable manufactured in this country for various purposes is very large. Occasion frequently arises to lay submarine cables in our rivers and channels, and the process is of considerable importance. This has been recognized in the recent construction by the Western Union Company of a new boat intended for cable laying purpose, as described in another column, in connection with the laying of a telephone cable across the Hudson River.

LAYING A TELEPHONE CABLE IN THE HUDSON RIVER.

PROBABLY few New Yorkers are aware that submarine cable operations are constantly being conducted in the river which separates Manhattan Island from New Jersey, and that a specially equipped cable boat carrying a trained staff is maintained by the Western Union Telegraph Company, to lay down and keep in repair the numerous cables crossing the North River. This boat, called the "Western Union," has been in commission since January last, and was built to replace the old "Orton," a vessel which had a long career of usefulness. The "Western Union" bears a general resemblance to a river tug, her dimensions being about 50 feet length by 14 feet beam. She is provided with twin propellers, which greatly facilitate manœuvring when at work cable laying or repairing. On the main deck, forward of the pilot house and bridge, is the cable drum. The drum is set vertically, the lower side bearing on a number of small rollers fixed to the deck. Round the edge of the lower side of the drum is a broad strap brake which can be nicely regulated so as to ease the drum or hold it back as the strain on the cable varies. The drum itself is revolved by a small engine supplied with steam from the main boilers. The wheel for operating the brake, and a sliding rod by which the valve of the drum-engine is opened or closed, are placed on the bridge just forward of the pilot-house, so that the foreman of the cable-gang has perfect control over the drum, and at the same time has a clear view of all that is going on. The rest of this combined paying-out and picking-up gear is very simple, consisting merely of a small iron pulley attached to the end of a long boom, which can be swung out over the side of the boat, abeam of the drum, the pulley hanging clear of the vessel's side by about 8 or 10 feet. Forward of the drum is a small steam winch, which does good service when the end of the cable has to be hauled ashore.

The equipment of the "Western Union" does not convey a very favorable impression to one who has been accustomed to the complete machinery carried by sea-going cable ships, but the gear, such as it is, seems to answer its purpose well, and presumably it is nobody's business to ascertain what damage is caused to a cable either in laying or picking up, by the defective arrangement of machinery employed.

The accompanying illustrations, from drawings made on the spot, show very clearly the general appearance of the boat when laying cable and also the details of the drum and pulley. The arrangement of the drum and pulley is open to many objections and would be looked upon with horror by most cable engineers. Fortunately the depth of water in which the boat generally works is quite inconsiderable, only some seven or eight fathoms, so that the strain on the cable is very slight and a heavy stiff cable bears on the little pulley at one point only, making a curve corresponding to a two or three foot pulley. In picking-up, however, matters must be somewhat different, and the horizontal winding-in on the drum coupled with the size and position of the pulley, rendering it difficult to give the cable a fair lead, must produce rather a queer state of affairs; and the cable is probably subjected to a very awkward and unfair strain. The objection is all the greater because all the cables in the North River contain a number of conductors, seldom fewer than seven and in some cases as many as eighteen, and such cables naturally require very careful handling to avoid any strain being thrown on the conductors unevenly.

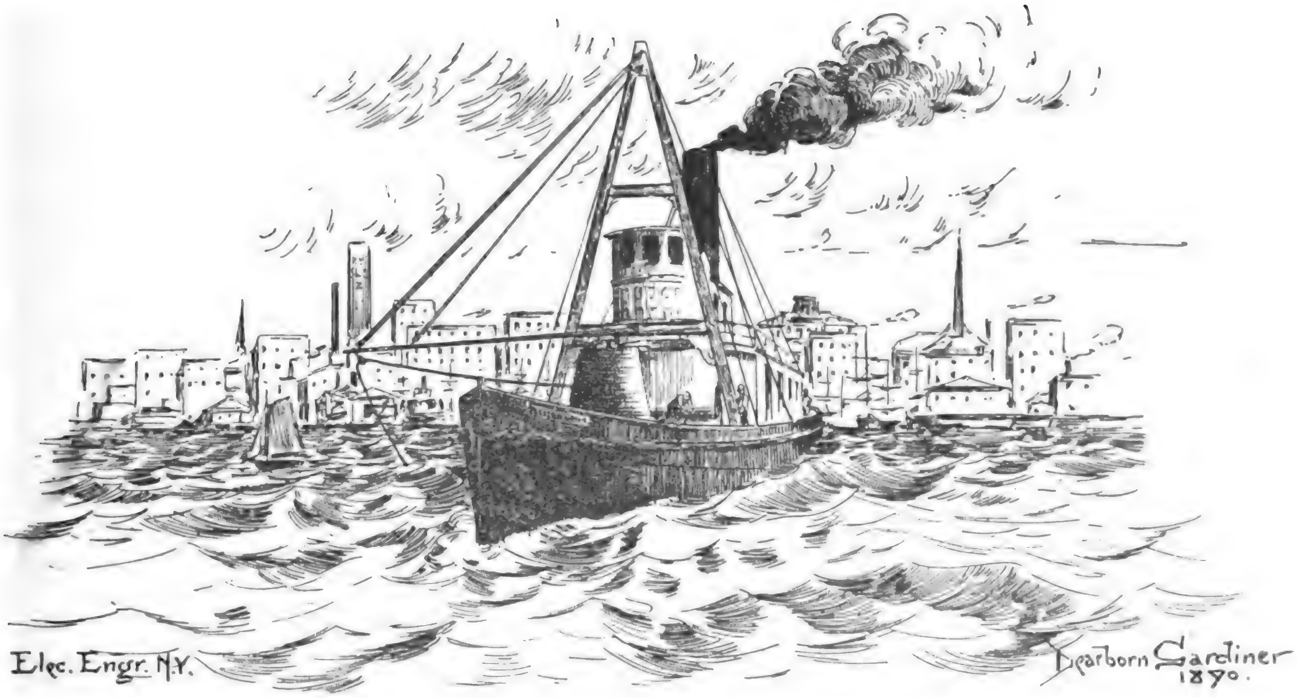


FIG. 1.—LAYING A TELEPHONE CABLE IN THE NORTH RIVER.

A few days ago the "Western Union," with her staff of cable hands under Foreman Kline, was chartered by Mr. George B. Prescott, Jr., the agent of A. G. Day, to lay a Kerite cable of special make containing eighteen conductors, for which a contract had been made with the Metropolitan Telephone Company. This cable is of a very heavy type, the length required for the North River crossing, about one mile, weighing not far short of twenty tons. The cable was transferred to the "Western Union" at Motthaven, where the factory reel was set up on jacks, and the cable wound on to the steam drum, both Mr. Prescott and Mr. Brixey, the superintendent of the Kerite factory at Seymour, being present to see that the cable was carefully handled, they also supervising all the subsequent operations. The steamer then set out for Pier 18, the landing-place on the New York side for the Metropolitan Company's cables. Here the expedition was joined by the representative of the telephone company, and by our artist,

Mr. H. Dearborn Gardiner, who made the drawings which accompany this article. The cable house is situated at the end of the Pennsylvania Railroad Company's ferry pier. Most of the cables already laid have been brought in through the piles of the neighboring dock, that of the Starin line of steamers, and in order to avoid crossing them with the new cable it was decided to take in the shore end from the end of the ferry slip, between the floating fender and the Starin dock. For this purpose a pulley was made fast underneath the cable house and a rope run out from the boat (stationed at the end of the slip) round the pulley and back to the steam winch on the boat. One end of the rope was made fast to the cable, the winch heaved in on the other and the cable was gradually hauled along to the cable house, the drum, of course, being revolved by its engine to ease the strain on the cable. This operation was effected much on the same lines as the landing of a shore-end from a regular cable ship, the only difficulty being that the irregular shape of the ferry-slip necessitated the hauling being done around a curve, the rope and cable bearing at places against the framework of the fender.

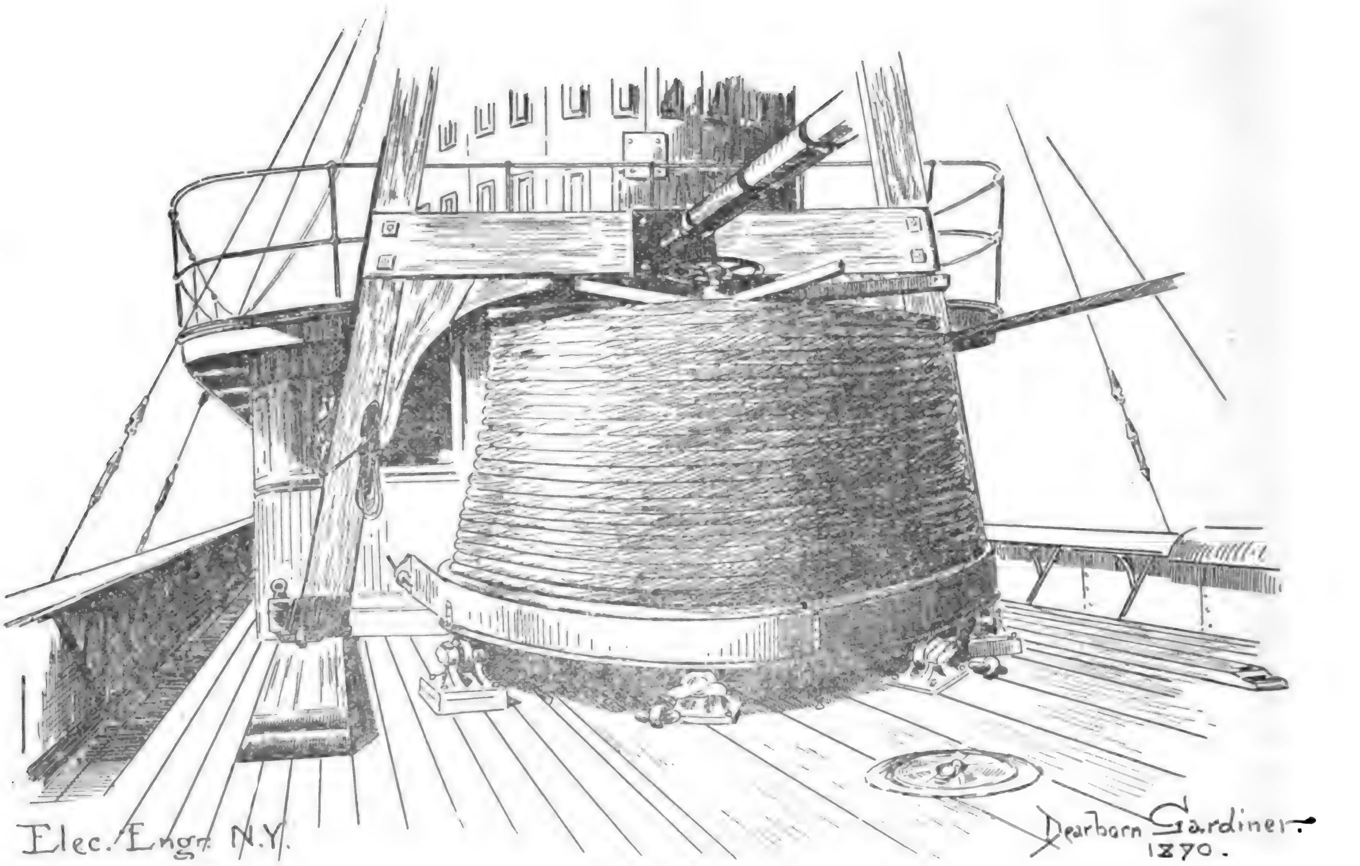


FIG. 2.—DRUM OF THE "WESTERN UNION" CABLE LAYING BOAT.

The end being successfully landed, the boat was quickly turned round by her twin screws and paying-out towards Jersey City was begun. This part of the work occupied but a very short time—some ten or twelve minutes—but getting the end into the Jersey City cable-house was the most troublesome job of all. Readers of THE ELECTRICAL ENGINEER will recollect that some time ago a number of Western Union cables were lashed and thrashed into shreds by the propeller of an Inman liner, and that quite recently the judge, in handing down his decision on the law suit which arose from this mishap, intimated that cables must keep out of the way of steamers, not steamers out of the way of cables, according to the custom that has obtained hitherto all the world over. Consequently the cables landing at this point are now taken under the Inman Company's pier, either on the bottom or among the cross-pieces of the piles.

The steamer made fast at the pier and the remaining cable had to be taken off the drum and coiled down on the dock-head. A rope was threaded through the piles and made fast to the cable-end, and the steamer, having taken up a fresh position at the foot of the dock, heaved in on the rope by means of the cable drum, thus hauling the cable through the piles. In order to get the end into the cable-house this operation had to be repeated once more, a rope being taken through the channel in which the cables run under the road, up through the cellar of the cable house and back again to the boat, and in this manner the cable was finally got into the cable-house.

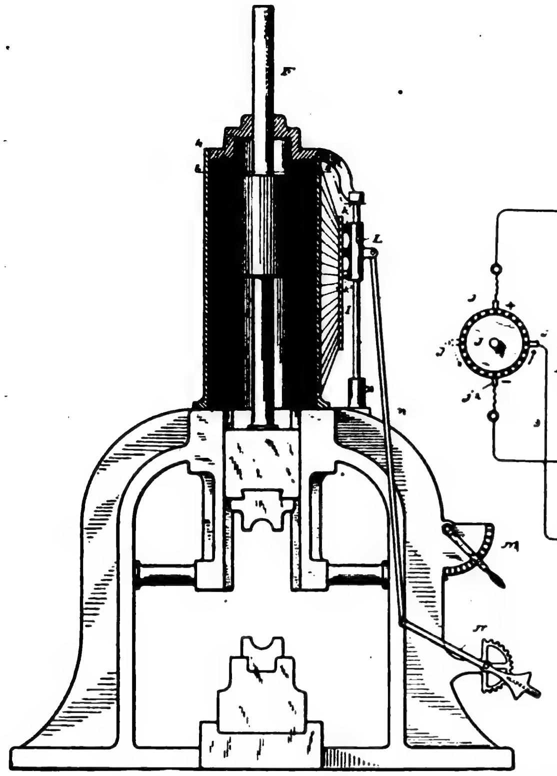
From the foreging description it will be seen that the laying of a heavy cable across the North River, under the existing conditions, is no light job. The actual laying is the simplest and quickest part of the work, but getting the ends in is quite a different matter, and the cables certainly have to endure a good deal of rough treatment. That they stand up under it and yield such good results is a convincing proof of the excellence of their manufacture.

VAN DEPOELE'S ELECTRIC POWER HAMMER.

IN the operation of power hammers for forging heavy work it is necessary that the hammer shall be able to strike directly upon the anvil or at any distance from it within the range of its stroke. To carry out this object in connection with an electric hammer, Mr. C. J. Van Depoele employs the well-known construction shown in the engraving, Fig. 1, which consists in the operation of an iron piston acted upon by a series of coils, which raise and lower the hammer according to the position of the switch governing the current passing to the coils. The special object of the construction adopted, however, is to obtain the range of motion. The piston reciprocates continually during the operation of the

machine in a constant but changing field of force, within which it may be said to float, rising and falling in accordance with the rise and fall of current above and below it, and, by moving the shifting field of force to any desired part of the motor-coils, the position in which the piston and connected parts will reciprocate can be changed at will and a blow delivered wherever desired—that is to say, the hammer can be made to strike directly upon the anvil or any distance therefrom within the limit of the coils.

The manner in which this is effected will be readily understood by reference to the diagram, Fig. 2. Here J is a



VAN DEPOELE'S ELECTRIC POWER HAMMER.

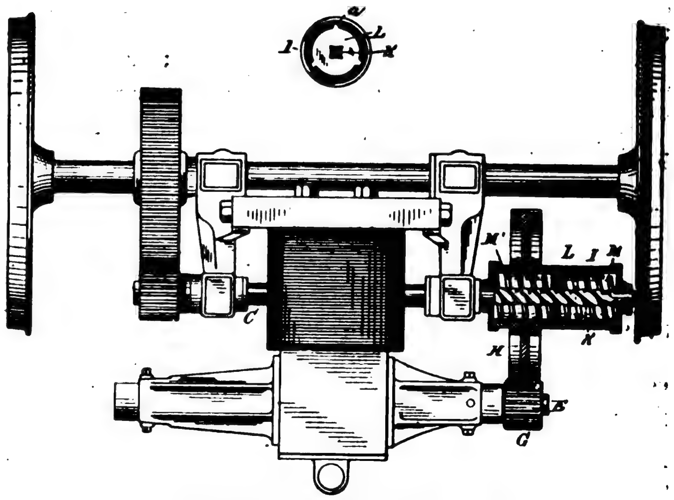
sectional commutator representing a source of continuous current. j^1 j^2 are the main positive and negative commutator-brushes, which are fixed upon the line of commutation. j is a moving commutator brush, the office of which is to cause the supply-current to rise and fall in the motor-coils by being moved around the commutator toward and away from the points of maximum and zero electromotive force. The brush, j^1, is connected with a contact-brush, k^1. The commutator-brush, j^2, is similarly connected with a brush, k^2, and the moving brush, j, is connected with a brush, k. The brushes, k k^1 k^2, are secured in a fixed relation to each other in an insulated carrier, L, Fig. 1, and maintained in contact with the commutator, I. With the positions shown in Fig. 2 current would flow through brush j^1, brush k^1, into coil 4, through coil 5, out through brush k^2, and back through brush j^2 to the commutator, J. The moving brush, j, being in central position, and, therefore, conveying no current in its travel about the commutator toward and away from the fixed brushes, will cause the current to fall in one of the motor-coils and rise in the other, and so on, so long as the brush, j, is kept in motion, it being apparent that the current which is continually rising and falling in the motor-coils is constant in direction and maintains a field of force which is gradually shifted back and forth between the coils in circuit with the brushes, k k^1 k^2; from which it follows that the piston, G, will move within the active coils, no matter in what part of the machine they may be. The current, never being interrupted or broken, the piston will therefore float within the coils without being able to escape in either direction. The speed at which the brush j is moved will determine the rate of reciprocation of the plunger, G, and in order to most conveniently regulate the power of the apparatus an adjustable resistance, M, is connected in the circuit as shown.

As a convenient means of conveying current through the circuits, the brushes k k^1 k^2 are, as stated, mounted in fixed relation to each other in a movable carrier, L, which is sustained in front of the commutator, I. In order to vary the stroke of the piston the brush-carrier, L, is adjusted up or down by means of a latch-lever, N, and a connecting rod. The lever, N, is located in a position convenient to the workman operating the machine, and the adjustable resistance, M, is also located in convenient proximity.

JOHNSON'S ELECTRIC CAR GEAR.

THE success which has attended the introduction of electric railways is sufficient proof of the immense superiority of this system over all others heretofore in use. But the experience gained in the past few years has brought out certain serious difficulties which are now well recognized, and which are claiming the attention of inventors to successfully overcome. Probably the defect most prominently brought out in the past, in the operation of electric cars, is that, while the power required to start the car is greater than that required when in motion, the electrical equipment is then least effective, and must, therefore, for the purpose of starting, be largely in excess of what is subsequently required, and even this provision is not always sufficient to avoid occasional injury to the motor by the excessive current which passes through the motor armature while the latter is at rest, and is developing no counter electromotive force.

To avoid this difficulty, Mr. E. H. Johnson, of this city, has recently designed and patented an electric car gear in which the power-transmitting value or capacity of the connection between the motor armature and the car axle will be constantly proportioned to the power required, and which enables the power to be applied gradually in starting. Attempts have heretofore been made to accomplish this highly important object by the employment of springs



JOHNSON'S ELECTRIC CAR GEAR.

interposed between the armature shaft and axle, and again, by means of frictional or rubbing devices. Mr. Johnson, however, has combined both of these in an ingenious manner by employing—associated with a frictional connecting device—a compression spring, which does not form the direct medium for transmitting the power, but which determines the frictional engagement of the connecting device, so as to adjust the power-transmitting capacity in accordance with the load. This novel result is accomplished by gradually interlocking a moving and a motionless shaft with an engagement whose value is positively progressive

until it equals the work to be done, and is afterwards invariably proportional thereto.

The manner in which this idea has been carried out in practice is shown in the accompanying illustrations. As will be seen, the motor is mounted as usual with a countershaft. The pinion, G, attached to the motor shaft, engages with the gear wheel, H, which is fixed on the hollow cylinder, I, forming a sleeve to the countershaft, C. The portion of the countershaft within the cylinder has a screw thread, K, cut upon it, the pitch of which is such as to allow the electric stop to reverse the apparatus readily and force the nut back on the thread.

The nut, L, shown in Fig. 2, which forms the intermediate connecting device, is threaded on the shaft, C, and is provided with lugs, *a*, which enter internal slots in the cylinder, I.

The operation of the gear will now be readily understood. When the car is in a state of rest, if current is applied to the motor, the pinion, G, turns the wheel, H, and cylinder, I. The nut, L, being in positive engagement with the cylinder, turns with it, and is, therefore, screwed up in one direction, or the other, according to the way the armature is running, along the shaft and against the spring, M or M′. The nut continues to turn until it reaches a point where the compression of the spring is such as to hold it back against the screw-thread with such friction that its turning movement is communicated to the counter-shaft; the latter then turns and starts the car, at first slowly and with increasing speed as the compression of the spring increases, until it reaches such a point that the nut will move no farther; this point being dependent on the load or the amount of resistance to starting which has to be overcome.

It will thus be seen that the load is brought gradually on the armature by the gradual compression of the spring, and the armature has time to make one or more revolutions and to begin to develop its counter-electromotive force before the load is placed on it. While the car is running the engagement of the shafts alters with variations in the load, so that the value of such engagement and the power transmitted change with the power required; that is to say, the point at which the nut engages with the screw-thread sufficiently to turn the shaft will depend on the load at the time of starting; and if the load afterward increases, the nut will run farther up on the screw-thread; or if the load decreases, it will be relieved and will run back toward the centre.

By the arrangement just described the shaft may also be automatically disconnected when the power is withdrawn, so that the car may run freely on down grades.

ELECTRIC LIGHTING ON THE S. S. "SEGURANZA."

THERE has just proceeded on her maiden voyage the S. S. "Seguranza," of the Brazilian Steamship Co., plying between this port and Rio Janeiro. The ship, which was constructed at Chester, Penn., is built of steel and iron upon the most approved plan, and contains all the modern improvements, together with some which have here been introduced by Capt. Lachland for the first time and which cannot fail to increase the comfort of the passengers.

Foremost among the good features is the electric light, there being no less than 400 incandescent lamps distributed throughout the ship. The electrical work, the equipment of which has been carried out by the Complete Electric Construction Co., of this city, was in charge of Mr. John A. Seely, and is noteworthy for the thoroughness with which every detail has been attended to. The entire wiring between decks is run in the Seely flexible rubber moldings, so that a double insulating protection is afforded. Every lamp on board the ship is provided with its individual cut-out. These are placed in blocks, so that should a burn-out take place, the removal of a single screw allows the block to be removed and a fresh fuse inserted.

Past experience has shown that in marine installations, switches are apt to be internally short-circuited through the medium of their metal cases. To avoid this, all switch cases between decks are made of the "S. & T." compound, which is not only insulating but largely fireproof. The switch bases are also made of the same compound.

All switches on deck exposed to the direct action of the weather and liable to be brought in contact with water are made water tight with the conductors passing through specially designed insulating bushings. The spindle to which the switch handle is attached is similarly provided with an insulating bushing, thus making the entrance of water impossible.

The ship has been specially designed to allow of rapid loading and unloading, there being no less than ten points at which this can be effected. To aid in handling the freight at night, special cluster lights have been provided. These consist of groups of six incandescent lamps placed under a reflector, and the whole is suspended on an arm, so as to throw the light downward, illuminating the deck and the side of the ship.

Still another important part of the equipment is a Huntington search light, similar to those employed on the Sound steamers. This is placed at the very bow of the ship, and has a full sweep of the horizon. The current of 10 amperes is taken directly from the incandescent circuit, which is run close to the side of the projector. With the aid of this light the entrance to harbors at night will be greatly facilitated.

The generating plant on board consists of a 400 ampere Continental dynamo connected directly to an automatic compound Ball engine of the new marine type, both mounted on the same base plate. The switchboard in the engine room has a slate base, which is probably the first of this kind placed on board a vessel, and indicates the care exercised to insure thorough insulation.

The entire plant, indeed, presents a marked advance in mercantile marine electric lighting, and the installation is a credit both to its designers and the owners of the vessel.

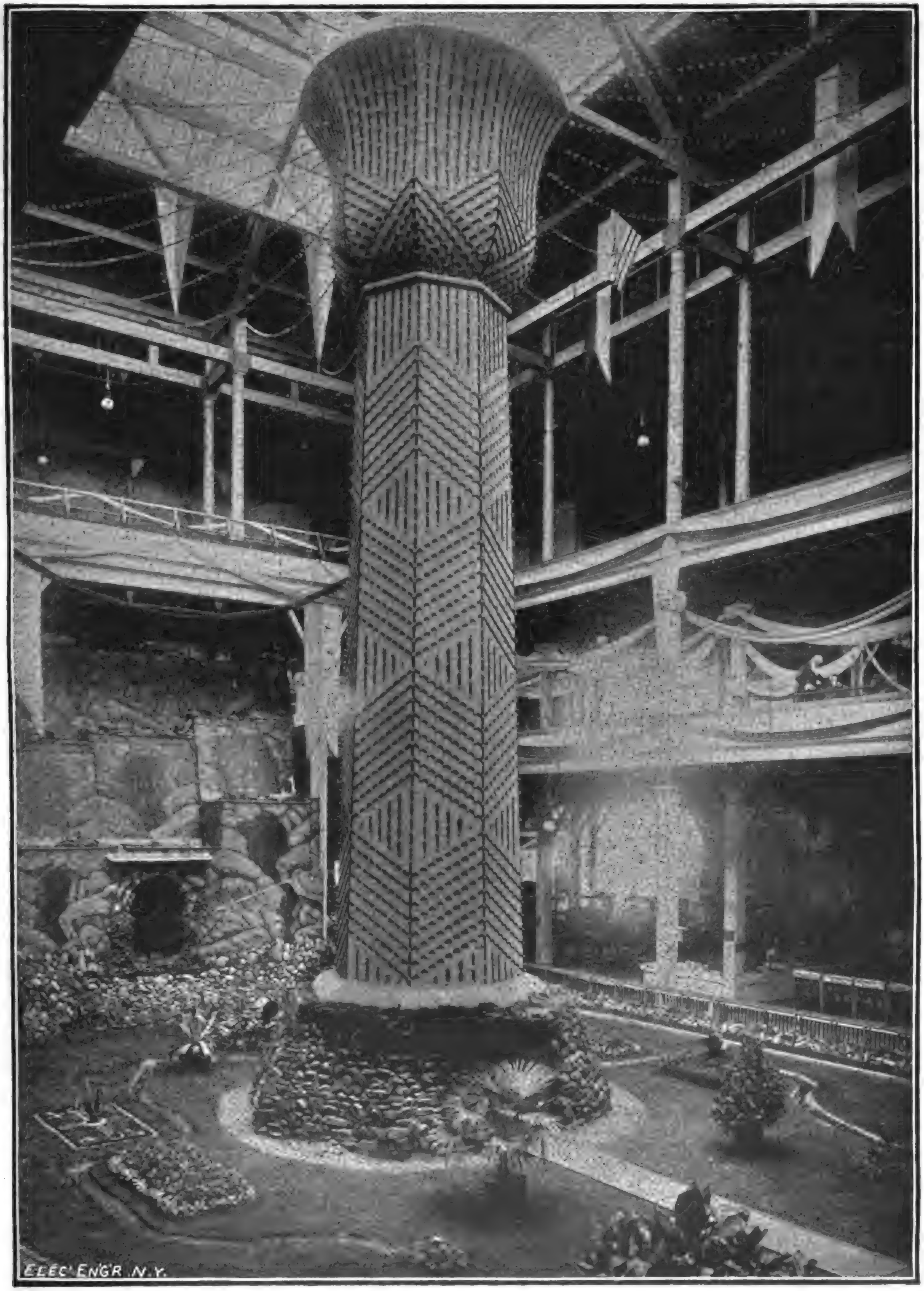
A MODIFICATION OF MR. EDISON'S EXPANSION GENERATOR.

BY W. M. MINER.

WHILE reading the article on Mr. Edison's method of generating an electric current, by the expansion and contraction of solid matter, in THE ELECTRICAL ENGINEER of Sept. 3, the idea occurred to me that as good, or better, results could be obtained from an alternating current, instead of a furnace as used by Mr. Edison.

The alternating current could by this means be converted into a continuous current for running motors, charging storage batteries, or for any other purpose, where a direct current would be most desirable.

My method of working would be something on this plan: I would make the metal expansion bars as light as possible, consistent with the necessary strength, and pass through them an alternating current of low potential, to heat them, instead of by hot air from a furnace, as proposed by Mr. Edison. This arrangement, I believe, would allow of more rapid expansion and contraction; the metal bars being light, would heat and cool quickly, allowing of more rapid making and breaking of the magnetic circuit. Consequently a more continuous current could be obtained, more elements could also be used, as the heat of each element would have less effect on the adjoining element, than it would from a furnace, as in Mr. Edison's arrangement. The shaft carrying the commutator in Mr. Edison's arrangement, could carry an additional commutator for distributing current to the metal bars.



THE EGYPTIAN TOWER OF LIGHT AT THE MINNEAPOLIS EXPOSITION.

THE EGYPTIAN TOWER OF LIGHT AT THE MINNEAPOLIS EXPOSITION.

When Mr. Henry Villard was in Minneapolis during the early Spring of this year, he made the citizens an offer to secure for them, and place at their disposal, as a special attraction for the Fall Exposition, the great Edison Exhibit shown at Paris in 1889 by Mr. Thos. A. Edison. This including the latest phonographs. A special feature, and one that rounds out the exhibit in a very remarkable manner, is the lighting spectacle furnished with the aid of the Edison Lamp Works, and represented in our engraving, Fig. 1.

The tower, which is tremendously popular, and is a brilliant success in more senses than one, was designed specially for this Exposition by Mr. Luther Stieringer, the

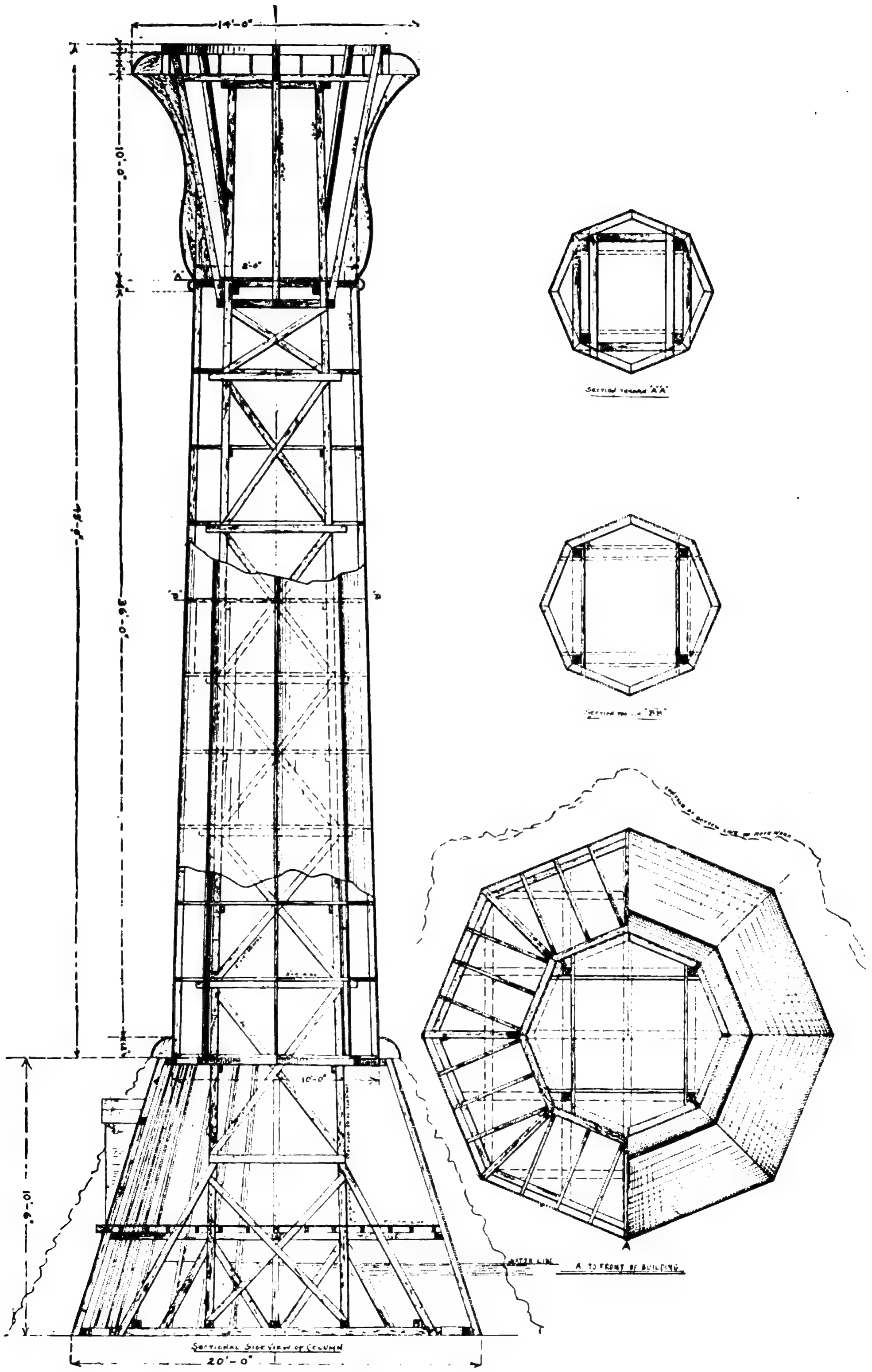


Fig. 2.—Details of Construction, Egyptian Tower of Light, Minneapolis Exposition.

generous offer was at once accepted, as well it might be, by the Exposition management. This exhibit as now being displayed at Minneapolis is wholly uncommercial in character, dealing only with the inventions as such, and well-known expert, and was the result of a special trip to the West, and weeks of patient planning. The tower may be said to present the most beautiful and bewildering arrangement of miniature incandescent lamps so far

attempted. When the immense audience assembled upon the opening night at the Minneapolis Exposition, they were amazed at the scene of splendor that lay before them. In the centre of the main building, which is three full stories in height, where there is a light well, 60 by 125 feet, stands the dazzling column, fully 60 feet high, in a blaze of grandeur, resembling a mighty lotus flower, with every separate part delineated. It stands on a rocky mound in the centre of a beautiful garden, through which a brook babbles, turning a rustic mill wheel as it speeds along across a grassy meadow where ferns and flowers grow in abundance. On one side a cascade comes rushing down, dashing against the rocks, tossing the silver spray, which is caught by the myriad colored lights, and sparkles like glittering gems.

The lotus flower is a marvel of elegance and beauty. In time with the music of the orchestra, the manipulator at the switches flashes the lights and produces the beautiful blending that charms and captivates the great audiences nightly.

The Egyptian column is fully 60 feet high, and is octagonal in form. The base, as it rests upon the garden, is 20 feet in diameter, while the diameter of the shaft proper at the base is 10 feet. The Egyptian cap is 14 feet in diameter, so that the extent of light surface is fully 4,000 square feet, or equal to the surface of the largest drop curtain on any stage. The details of its construction are shown in the engraving, Fig. 2.

The surface presents a marble-like appearance, which is produced by a covering of diamond dust. The lights are arranged in lines forming geometrical designs. They are in receptacles on mahogany-colored strips, closely studded

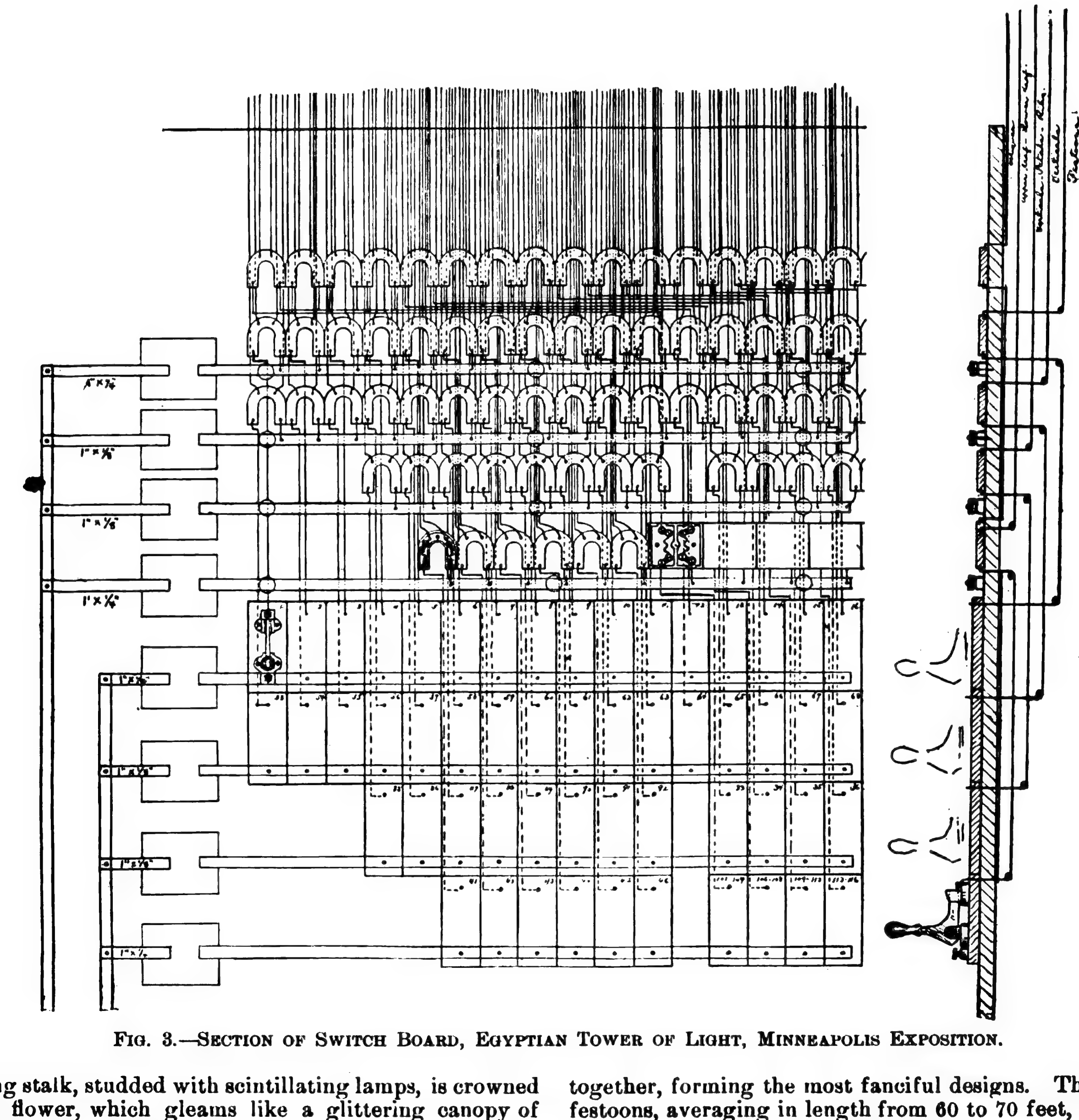


FIG. 3.—SECTION OF SWITCH BOARD, EGYPTIAN TOWER OF LIGHT, MINNEAPOLIS EXPOSITION.

The long stalk, studded with scintillating lamps, is crowned by the flower, which gleams like a glittering canopy of rich light. The petals as they bend down from the corolla are many hued. Radiating from a common centre in the calyx across to the roof of the great light well, are the stamens of the ripened flower. These, represented by festoons, are also of many colors, and as one looks up from below they complete the glory of the fascinating picture. Rushing through a tunnel underneath the falls, disappearing from sight, again to show an instant through the crystal flood, over trestles, and across bridges, is a swift-running miniature electric train.

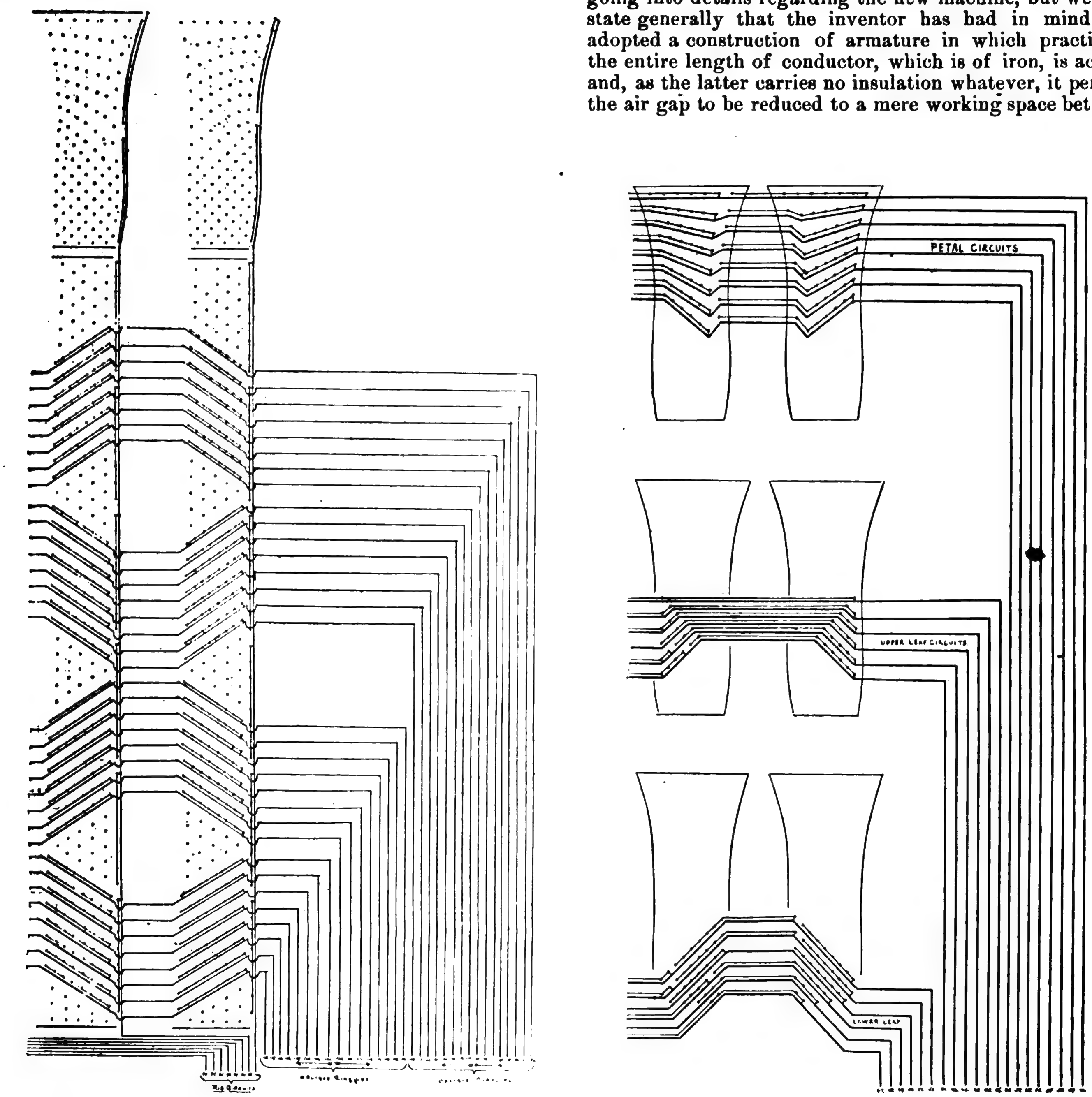
together, forming the most fanciful designs. There are 32 festoons, averaging in length from 60 to 70 feet, in each of which are over 100 parti-colored lamps.

There are two No. 20 Edison generators provided, having a capacity of 900 amperes. The dynamos connect with the light tower through "interior conduit" underground conductors to the switchboard, a part of which is shown in Fig. 3, where the manipulator produces the varied combinations and effects which are the wonder of all, especially when the light is slowly turned on in the festoons, and speeds along its course until the whole bursts into a blaze of light. The plans of wiring adopted for

different parts of the tower are shown in Figs. 4 and 5.

There are fully 10,000 lamps on the tower. Along each of the octagonal corners run perpendicular lines of purple lamps, while in keeping with the botanical structure of the lotus flower, the leaves of the calyx are green. The vertical lines are red, while the festoons and petals are variegated.

The construction of this Egyptian column with its canopy of light shows the capability of miniature lamps for structural effects. It would also have been impossible to have accomplished this feat but for the long



FIGS. 4 AND 5.—PLANS OF WIRING, EGYPTIAN TOWER OF LIGHT.

and careful preparations which were made. This necessity of attention to detail was fully appreciated by Mr. E. W. Hammer, the constructor to whom the plans were entrusted. The work of wiring was done with a special view to safety, and the work done appears as though it were to last for years instead of for six or eight weeks.

This Exposition is but the second occasion in which the miniature lamp has been used commercially in any great number, and the ease with which it can be handled, and the results which can be obtained for decorative and other purposes, in halls, theatres, churches, etc., promises well for the future of this branch of the electric light industry.

A NEW MULTIPOLAR DYNAMO.

WE have recently had occasion to inspect in course of construction a novel type of multipolar slow-speed dynamo designed by Mr. R. Eldridge, of this city. The exigencies of patent applications, now pending, prevent us from going into details regarding the new machine, but we may state generally that the inventor has had in mind and adopted a construction of armature in which practically the entire length of conductor, which is of iron, is active, and, as the latter carries no insulation whatever, it permits the air gap to be reduced to a mere working space between the iron of the armature and the iron of the field magnets. The construction of the machine is being actively pushed, and the inventor hopes soon to give it a practical trial.

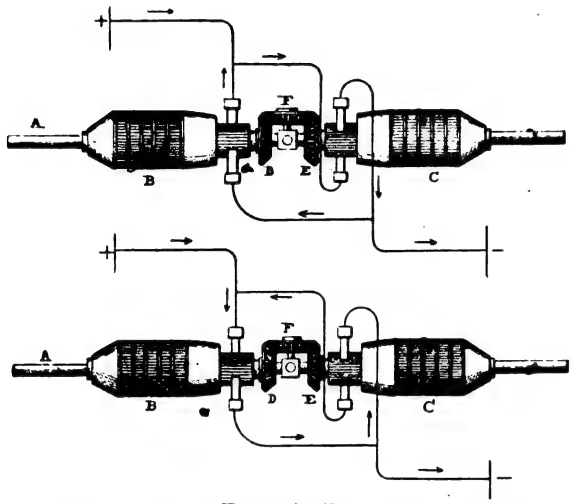
EDISON GENERAL ELECTRIC CO.—The company has appointed Mr. S. B. Paine Edison agent for the New England District, including Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island, with headquarters at Boston.

EDISON'S ELECTRIC CAR GEAR.

Recognizing the importance of the electric railway as a part of the modern applications of electricity, Mr. Edison has of late again devoted attention to this branch and particularly to the method of gearing between the motor and the car axle. The problem involved is essentially that of obtaining any desired variation in speed and direction of rotation with the least waste of energy and by the simplest methods.

Among the various ways in which Mr. Edison has worked out this problem, is one in which he couples two machines together and works them differentially, as it were, converting one or the other into a dynamo or a motor as the exigencies of the service require.

The accompanying illustrations, Figs. 1 and 2, show the principle here adopted. Mounted loosely on the shaft A, so as to turn independently, are two electric motors, B C, the armatures only of which are shown for simplicity of illustration. These armatures are connected with the line circuit and carry on their adjoining ends two beveled gears, D E, which turn with the armatures, independent of the shaft, and which engage with opposite sides of an epicyclic gear, F, mounted upon a stud fixed to the shaft between the armatures. If the two armatures are revolving in opposite directions with equal speed, it is evident that the epicyclic gear F will be simply rotated without exerting any rotary effort upon the shaft A, which will remain at rest. This condition of affairs may be assumed to be reached when the field magnets of the two motors are of equal strength.



Figs. 1 and 2.—Edison's Electric Car Gear.

When it is desired to rotate the shaft in the direction indicated by the arrow in Fig. 1, the field-magnet of the motor B is strengthed, while that of the motor C is made weaker. The effect of this is to accelerate the speed of motor C, and retard that of motor B. The difference in the speed of the motors will result in a rotation of the shaft A in the direction shown in Fig. 1, the machine B, under these circumstances, acting as a dynamo, while the machine C acts as a motor.

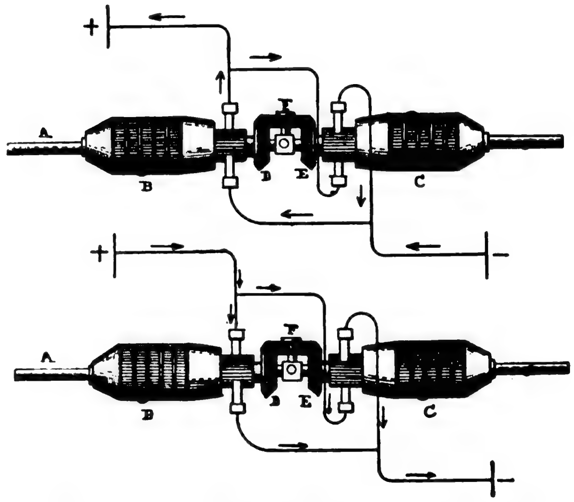
If it is desired to reverse the direction of rotation of the shaft A, as indicated by the arrow in Fig. 2, the relative strength of the field magnets of the two motors is changed, the field-magnet of motor B being weakened, while that of motor C is made stronger. Now the machine C becomes a dynamo, while the machine B acts as a motor, the speed of the shaft A being equal to the difference in speed between the two machines.

Thus it will be seen that a reversal of the direction of rotation of the shaft A may be accomplished without reversing the direction of rotation of the machines, and that the rate of speed of the shaft in either direction may be varied within wide limits, or the shaft may be brought to a standstill without stopping the motors.

Under the conditions shown in Figs. 1 and 2, the current will be taken from the main circuit in proportion to the energy developed, while the machine which is acting as a dynamo will deliver its current through the local circuit, as indicated, to the other machine, acting as a motor, thus economizing the current which is delivered to the machine acting as a dynamo and redelivering the energy, less the percentage due to conversion, for the performance of useful work in the machine acting as a motor. Thus an economical arrangement is produced.

In the application of the idea to the propulsion of street cars, an additional condition will be introduced if it is desired to stop the car while maintaining the circuit-connections of the machines. Considering that the shaft A is a car axle which is being driven in the direction indicated in Fig. 2, and it is desired to stop the car, the field-magnets of the two machines are brought to the same strength, or that of machine B is made stronger, to any degree desired, than that of machine C. The conditions while the car is being propelled forward by its momentum will be as indicated in Fig. 3. The shaft A will then be delivering energy to the machines, with the result of sending current back upon the main line as indicated by the arrows. The machine B becomes a dynamo, and the machine C a motor; but the current taken by the motor will be less than the current delivered by the dynamo. If the car were running in the other direction, as indicated by Fig. 1, the braking of the car would produce the reverse relation of the machines, machine B becoming a motor and machine C a dynamo.

For the driving of some kinds of machinery it is often desirable to produce a greater variation in the speed than can be secured when the motors are capable alone of being driven in opposite directions. In that case the motors



Figs. 3 and 4.—Edison's Electric Car Gear.

may be arranged for independent reversal of their direction of rotation, so that under some circumstances the motors may both be run in the same direction, as indicated in Fig. 4, and while running in the same direction the shaft A will have its greatest speed when the two machines have an equal maximum speed. Thus the speed of the shaft A may be increased from a position of rest to the maximum, which can be secured by running the machines in opposite directions, and then the speed can be further increased by reversing the direction of rotation of the slower machine, so that instead of detracting from the speed it will actually add to it, and the speed will be further increased as this slower machine is brought up to the same rate of rotation as the other, when the maximum speed of the shaft will be attained.

One way in which the principle described above can be carred out in practice, is shown in Fig. 5. By the method of connection here shown, the motor-armatures as well as the field-magnets are connected in multiple arc with the main circuit. A resistance H is located in the field-circuits of the two machines B C, and is adjusted by means of a switch I in such manner that the portion of the resistance on the right of the switch is in the field-circuit of the machine C, while the portion of the resistance on the left of the switch is in the field-circuit of the machine B. The shifting of the switch to the left diminishes the re-

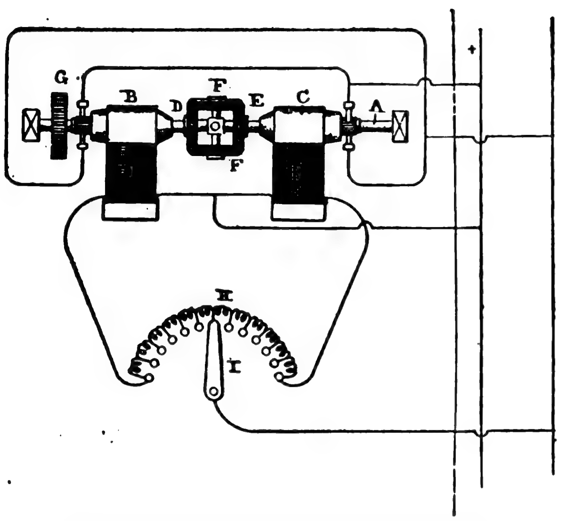


Fig. 5.—Edison's Electric Car Gear.

sistance in the field of the machine B, and increases that in the field of the machine C. A movement to the right produces the reverse effect. If the switch stands at a central position, making the resistances in the two field-circuits equal, the two machines will have an equal speed in opposite directions, and the shaft A will remain at rest.

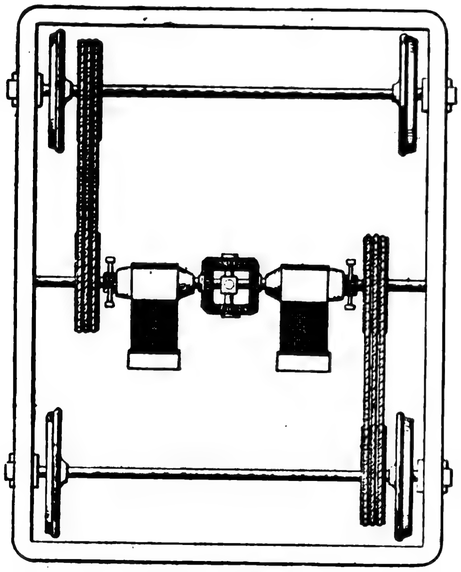


Fig. 6.—Edison's Electric Car Gear.

By throwing the switch to the left the field-magnet of the machine B is strengthened, while that of the machine C will be weakened, resulting in the conditions illustrated by Fig. 1, referred to above, and producing a rotation of the shaft at a speed which is proportional to the difference in the speed of the two machines, and which may be varied within wide limits. By swinging the switch to the right, the field of the machine C will be made strong and that of the machine B weak, and the conditions illustrated by Fig. 2 will be obtained.

The engraving, Fig. 6, shows the method of connecting the driving shaft to both axles by means of rope-gearing, thus equalizing the weight and traction between both axles.

A NEW CURVE INSULATOR.

The successful and economical operation of electric railways depends largely on the proper line construction, *i. e.*, on ample strength of all the parts put under strain, and thorough insulation of the trolley wire from the ground. Owing to the weight of the trolley wire the supporting devices must be very strong, yet they must insulate the trolley line from the supporting wires. This is the more true at curves, where the same strain which is too much for an ordinary iron pole is put on the single centre curve insulator. It is not surprising that some of the forms now in use have not withstood so severe a test in practice, and have either lost their insulating properties or have partly crumbled up. Such a fate seems impossible for the new form

A New Curve Insulator.

which we illustrate herewith, the "Treble" centre curve insulator, designed by Mr. Wm. Sharp for the Great Western Electric Supply Co. This is made of iron pieces bolted together and insulated from each other by hard rubber dashers and bushings. As the cut shows, the three rubber bushings are in series, giving a treble insulation. A rubber sleeve fitting snugly over the insulator keeps this dry, so that the three-fold insulation is obtained in all kinds of weather. The sleeve by enclosing the insulation also prevents any possible deterioration of it. The cut does not show this sleeve, but it shows the disposition of the iron and rubber parts, which are made unusually strong and promise to withstand the severest practical tests.

A NEW ELECTRIC CAR STARTER.

One of the greatest difficulties which has assailed the electrical engineer in designing apparatus for electric street car service is the requirement for an excessive amount of power to start the car from rest. Almost all the cars in service to-day are fitted with about 30 h. p., evidently far too much to keep a car in motion at any speed up to 12 or 15 miles an hour, 10 or 12 h. p. being generally conceded to be sufficient. This extra power is necessary solely to start the car from rest, and electricians will admit that it takes frequently over 40 h. p. to set an ordinary car in motion. Any device which will obviate this difficulty is worthy of serious consideration, and will be welcomed by all street railway men. Mr. John H. Palmer has recently brought to Boston a working model of a device which bids fair to prove an unqualified success, and whose principle consists in having a variable leverage mechanism, obtained by involute wheels, by which an enormously increased leverage is attained on the driving wheels at the moment of starting the car and for some time after. After getting the car fairly set in motion this mechanism is automatically cut out, and the motor continues to drive the car in the ordinary manner, another clutch automatically gearing into the driving shaft an instant before the starting mechanism is cut out. The model works most accurately, and exhibits some very pretty mechanical devices. Experts who have seen it, are agreed that the whole device has been most carefully worked out, and will undoubtedly do all that is claimed for it when put in actual operation. The motor can either be kept running all the time or stopped with every stop of the car, if so desired.

The Turtle Creek Valley Electric Company, of Wilmerding, Pa., is about to add a sixty light arc machine of the new Westinghouse alternate current type to its central station equipment. It already has in service fifteen hundred lights capacity of Westinghouse incandescent dynamos.

THE OPERATION OF THE DOUBLE CORD KEYBOARD AT BROOKLYN, N. Y.[1]

BY GEO. J. DAVISON.

A YEAR ago I addressed a somewhat extended report regarding the workings of the new multiple switch at Brooklyn, as then operated with the single cord keyboard. On account of the troubles therein shown, and because it was essential that we should be able to operate mixed circuits in the multiple board, it was decided to change the keyboard from the single cord, grounded system, to the double cord metallic. This change was completed early in March, 1890, and the new keyboard has, therefore, now been in use for about six months. The equipment is full metallic, with tubular clearing out drops, retardation coils, condensers, split telephones, etc., etc.

The change required the connection of answering spring jacks, which were placed horizontally in the lower part of the switch, necessitating the moving upward of all the spring jacks originally connected. This movement disarranged the switch cable wiring to some extent, and increased the liability to troubles in that particular, but very little has developed. The wiring of the line drops had to be entirely renewed, they having been wired originally for grounded circuits only.

The number of troubles, as shown by the table herewith, is very small, and those occuring were almost entirely of a trivial nature, readily located, and easily removed. In the parts of the apparatus not referred to in the tablulated form, there has been scarcely any trouble. After the change of keyboards had been completed new transmitter cords were put in, none of which has failed; triple receiver cords were necessarily substituted for the double cords; only one of these has failed.

One of the condensers became short-circuited, the result of which was to cause all grounded circuit lines to test "busy" whether in use or not. The split telephones have been very satisfactory, no trouble whatever having been experienced in their use.

Spring Jacks:—We have added 1,720 spring jacks to the 15,600 in use last year, making 17,380 now in use. For the first thirteen months' use there were ten cases of dirty contact; for the past six months there have been 22 cases of this trouble. I think this increased percentage of trouble is due to a considerable extent to the disturbance of the switch cables at the time of changing the system, which set free whatever slight accumulations of dust there was in the cables, no small portion of which found lodgement in and about the spring jacks. None of the spring jacks has platinum contacts the use of which would, I think, lessen this difficulty.

Drops:—There are 1,770 in use, an increase of 110 over last year's report.

The troubles with these have been much fewer than was previously shown, comparing as follows:

	13 Months, 1889.	6 Months, 1890.
Catch	26	3
Shutter	36	8
Armature Trunnion	203	None
Crossed with Core	6	1
Open in Coil	2	1
Burned out	1	5
Broken Wires	20	8
Total	294	26

None of these troubles requires any special comment, the cause of, and remedy for, each being apparent.

Ringing Keys:—The ringing keys are of the pattern known as "long distance metallic," and there are 273 pairs, or 546 individual keys in use. Only five cases of trouble have developed, four of these being a failure to ring, caused by the generator springs not being properly adjusted, being so far away that the depression of the button did not close the contact between the line and generator springs. The remedy was easy and is obvious.

The other case of trouble was where the button, being depressed, would not return to its normal position. This was due to a slight roughening of the sides of the wedge-shaded rubber plunger where the springs rest against it. A little oil applied at the point of trouble was all that was necessary.

Listening Keys:—There are 273 listening keys in use, with which there have been forty-one cases of trouble, no one of which, however, was in the main line circuit, or interfered with the subscribers after a correction had been made. These 41 troubles may be divided into four classes, as follows:

Failing to cut-in operator	9
Failing to cut-out operator	1
Rubber plunger sticking	27
Rubber pin broken	4
Total	41

1. Read before the National Telephone Exchange Assoc., Detroit, Sept. 10, 1890.

Failing to Cut-in Operator:—The nine cases of this trouble occurred in the first two months, and on account of the springs not having been properly adjusted when they were connected. The springs rested against the rubber plunger and did not close the contacts on the operator's circuit. No recurrence of the trouble after properly adjusting the springs by bending them.

Failing to Cut-out Operator:—Only one case of this trouble, caused by the rubber pin of the plunger being so short that the "throw" was not great enough to break the contacts.

Rubber Plunger Sticking:—This trouble occurred twenty-seven times, and, as in the case of the ringing key, was where the plunger remained down, when the cam was thrown forward. It was due, to some extent, to a lack of proper smoothness of finish on the wedge-shaped sides. The plunger is pressed upon by two springs on one side and one on the other, the unequal strain having a slight tendency to make it bind. The difficulty was readily overcome by rubbing a little oil on the sides of the "wedge."

Broken Rubber Pin:—Four of the little rubber pins which are acted upon directly by the cam became broken from some unknown cause. The cams of the listening key make considerable noise when they are thrown forward, but I do not know how this can be avoided.

Tubular Clearing-Out Drops:—Two hundred and seventy-three are in use, which have required attention twenty-three times. All of the troubles, except two, were with the catch. The drops are located directly in the rear of, and on a level with, the cords, the plugs of which in being returned to their normal position occasionally strike against and bend to some extent the rather slender catch of the drops, which, in consequence, fails to release the shutter. The remedy for these troubles, after their occurrence, is obvious. To guard against them the drops should be located elsewhere, which, however, is not practicable in this switch. The "adjustments" referred to were, where the armatures were too loose, requiring the changing of the position of the trunnion binding screws.

Cords:—It appears from the record that only about thirty-five per cent. of the cords in use had failed during the six months. As a matter of fact, a percentage of failures of the cords *actually used* is much greater. Each of the subscriber operators has eighteen pairs of cords available, but habitually uses a much smaller number, a half dozen or so pairs of cords being used for the greater portion of the connections, the other pairs in a lesser and lesser degree according to the volume of business. There were a few failures of the cords at the point of soldering into the shoe, inside of the plug, but the percentage of troubles from this cause is very low.

Almost all of the failures are just at the base of the plug, due to the strain upon the cord in withdrawing the plugs from the spring jacks. The breaking of the tinsels is increased considerably by the perspiration from the operators' hands penetrating the covering of the cords. It is the rule that operators shall withdraw the plugs by taking hold of the same and not by the cord, but it is almost impossible to enforce the rule on long reaches.

The percentage of cord troubles in the double metallic is very much greater than in the single cord, grounded system. In the 13 months' use of 1,200 single cords there were only eight failures, as against 209 failures in six months out of 576 in use in the double metallic. There are two prominent reasons for this increased percentage; first, because as there are two conductors in the metallic circuit cords the liability to trouble is doubled in the same number of cords, and second, because in the double cord system the use of the cords is so much greater. In the single cord system a cord is not used except to complete the connections for which the subscriber, of whose line it forms a part, may call, while in the double-cord system a pair of cords may be used any number of times, in fact, may be used almost continually.

The one case of trouble "conductors crossed in cord" was caused by abrasion of the insulating material. The effect of such a crossing of the line or test is that any grounded circuit subscriber's line tested with that pair of plugs would show "busy" whether in use or not.

Plugs:—The troubles with the plugs have not been many, amounting to thirteen in all out of 576 in use. Four tips of plugs were broken off in the spring jacks, due, however, more to accident and a lack of care than to faulty construction of the plugs.

The removal of one of these tips from a spring jack is a somewhat difficult matter, when it happens to be broken off when the plug is wholly within the jack, and the tip held fast by the line spring. It is then necessary to relieve the tension of the spring by partially, or wholly, withdrawing the screw holding it in place and pushing the tip forward until it is within the sleeve of the "test." From this point I find the most convenient plan of removal to be the use of a short piece of flexible rubber tubing, —placing one end of the tubing firmly over the opening of the spring, a quick inhalation of breath rarely fails to bring it out.

Tips Unscrewed:—The little rivet used to prevent such troubles has come out of nine plug tips, rendering it unsafe to use the plug until repaired.

Referring to last year's report, it will be seen that in the thir-

teen months' record there were 459 cases of trouble with the combination key and 76 with the grounding jacks, a total of 535 in the single cord key-board, or an average of a little over 41 per month. The report herewith for six months shows troubles in the double cord keyboard as follows: Ringing buttons, 5; listening keys, 41; clearing out drops, 23; a total of 69, or an average of 11½ per month. When it is further considered that about forty per cent. of the troubles in the single cord keyboard interfered with the subscriber's conversation after the connection had been made, and that not one of the double cord troubles interfered in this way at all, the contrast is very great.

Add to this, too, the great difference in the ease with which repairs may be made to the double cord system, and that the making of such repairs need not interfere with the operator's efficiency, nor with any subscriber's line, it seems to me that there can be but one conclusion arrived at.

CORPORATE ORGANIZATION.[1]

BY E. J. HALL, JR.

CORPORATIONS have been called "artificial persons," owing their existence to the creative power of the State, and designed by process of law with more or less skill to approximate natural persons in their powers and duties.

When the legislative powers are exercised wisely and skillfully and these artificial persons have been properly constructed, they take their place in society as most useful members, serving the needs of the public in many ways with far greater efficiency and reliability than any natural persons possibly could; for while it may be true that corporations have no souls, it is equally true that they are not subject to paralysis or indigestion.

On the other hand, their design being subject to the fancy of legislative bodies, these artificial persons are sometimes over-developed in some directions and lacking in others, the builder who follows the legal specifications, often finding that parts essential to some material function are wholly omitted, while others are so dwarfed or magnified as to be out of proportion to the symmetry of the intended design.

In the early days of these new members of society the natural persons then composing it had a feeling of, perhaps not unnatural, alarm that if these artificial persons became too big or too numerous they might be troublesome neighbors. What, for instance, if the power which gave them legs and arms should take a notion to add cloven feet, horns and a tail?

This has, from time to time, occasioned the introduction of various restrictions into the specifications, some of them doubtless wise, others unquestionably unwise; but with a realization of the fact that society had not lost, and could not lose, the power to protect itself, has come a better understanding of the benefits to be derived from properly constructed corporations and a disposition to formulate the specifications so that their construction shall be encouraged and their capacity for work utilized to the fullest extent by society.

The tone of the press during the recent labor troubles on the New York Central Railroad reflects a marked change in public sentiment from that existing even a few years ago, and, to some extent, this change is due to a better understanding on the part of corporation managers of the obligations which rest on them to so organize their forces that the public shall be efficiently served, stockholders receive proper returns, and last, but by no means least, that employés shall be justly compensated and fairly treated.

To organize and conduct a corporation so as to fully meet all these obligations is no easy task. In my own work I have been greatly helped by making diagrams of any proposed arrangement of forces, for the purpose of studying from that the exact relations which would exist between various departments and employés if the plan were carried into effect.

Almost invariably the study of a diagram brings out unexpected defects of arrangement or suggests changes which would improve the efficiency of the force. President Sargent has asked me to explain this diagram system, and I am glad to comply with his request, because I believe there is for us no more vital problem than the best method of constructing the "artificial persons" who are furnishing the public with its telephone service, but for whose actions we are all largely responsible. I do not see why we should not go at this just as we would at the construction of any piece of mechanism. Surely it is more complicated and more delicate than any of our electrical apparatus, and, at the same time, its motions are attended with such consequences that we cannot afford to make any mistake.

When we undertake to prepare plans and specifications for the construction of an "artificial person" to conduct the business of a telephone exchange, we must look, first, to the statutes of the State, in which we will find the legal specifications. From them are prepared the charter, articles of incorporation, which, in a general way, define the nature of the proposed corporation and the position which it desires to occupy in relation to the State, while the by-laws, which are to some extent controlled by statute, provide, generally, for the relations of the corporation with its stockholders. By the articles of incorporation and the by-laws provision is made for the control of the corporation by trustees or directors elected by the stockholders, and by certain officers, usually a president, secretary and treasurer, elected either by the stockholders or by the directors. These officers are common to all corporations, and are charged with certain duties by the State and by the by-laws.

It would be interesting to go more fully into the relations thus established between the new corporation, the State which gives it being and the stockholders who risk their fortunes on its success. We will not, however, stop to do so now, because we are considering to-day only the executive forces, the *physical structure* of our "artificial persons." The functions of the officers named will be considered only as they relate to the performance of the work for which the forces are to be organized.

The unit of work, that is, the amount which can be performed by one person, is very small, so we must subdivide until each part of our work receives its proper share of attention; but, as all of the parts are inter-related, it is evident that there must be somewhere a single central authority, for the division means chaos. From this central authority there must be a direct line of communication to every department and every employé; no matter how many departments or employés there may be, this line must be kept in good working order, free at all times from breaks and crosses.

To carry our simile of the artificial person a little further: When, in a natural person, the stomach wires the brain for supplies, the feet must receive orders to move toward them, first one, then the other; they cannot be left to argue between themselves as to which small move first; then the hands must do their work and, at the right moment, the mouth must be ready to do its part, and so each member performs its office as the orders are sent over the connecting lines, and reports from each keep the brain constantly advised of the manner in which its instructions are being carried out.

To construct a diagram of these lines of communication will help us to see how best to arrange the various parts of our artificial person to secure as exact results. For convenience we will call this main line the "Line of Authority," and extend it unbroken from the management to each employé. Other lines there may be, and must be, to unite all the parts of our mechanism into a complete working body, but they must never be mistaken for, or tangled with, the line of authority, or confusion will follow.

On the accompanying diagram which I have made, we can trace now the line of authority originating with the stockholders, extending to the Board of Directors, then to the President, then to the General Manager, and dividing at that point, branches extend to each department chief and through him to his subordinate officers, superintendents, managers, foreman and so on until it reaches the last messenger boy.

The general office is particularly the department of the general manager. Its work consists: *First*—In receiving and recording the orders of the president and directors and transmitting them to the proper persons for execution. With the orders must go the funds and materials for carrying them into effect and the details of the methods to be followed. *Second*—To the General Office must come back the reports and results of all work, which must be recorded and transmitted in proper shape to the Directors. *Third*—Through the General Office all arrangements must be made for *transfers* from one department to another.

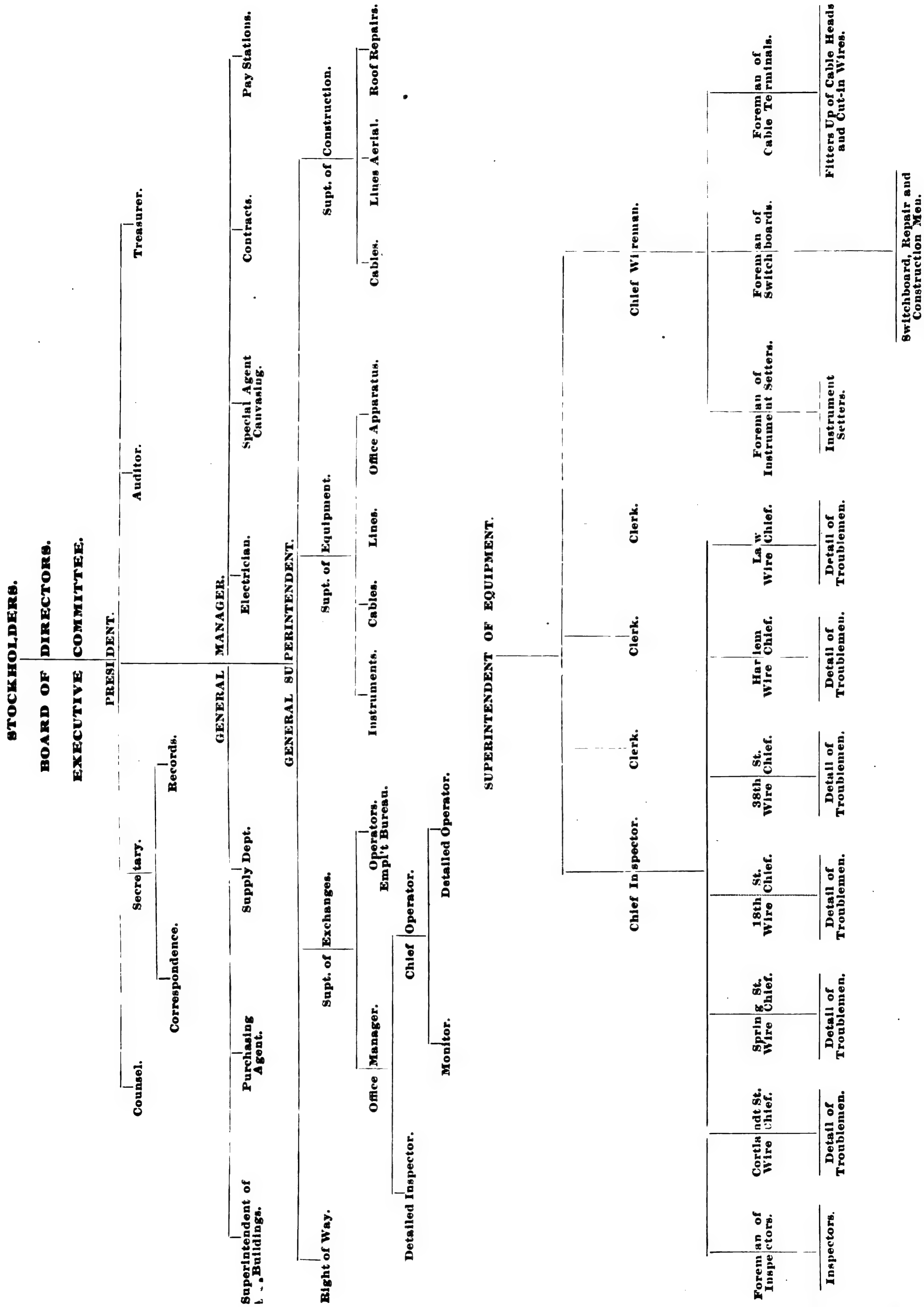
The General Manager acts as the connecting link between the authority which shapes the plans and controls the policy of the company, and the forces which carry those plans into effect. He should be identified as closely as possible with both, and this is often accomplished by making him a member of the Board of Directors, thus enabling him to fully understand the nature of the results to be accomplished, while, at the same time, his close relations with the working forces enable him to keep the Directors fully informed as to the condition of the company's plant and forces, their possibilities and needs for accomplishment of any desired result.

The General Manager, as the diagram shows, has no authority over the Secretary, Treasurer, Auditor, or any employé on the President's line, but such relations as are necessary must be established by order of the directors or the president, unless, as is often the case, the General Manager is also Vice-president, in which case his relations are established by the *latter position*.

This distinction is important, and it applies equally in the case of all relations between officers and employés of different grades when one person fills two offices not on the same "line of authority."

The General Manager should be responsible for the appointment of all employés on his staff or below it, but it does not by any means follow that he should in person select all individuals for appointment; on the contrary, holding a veto power over all, he should select none but his personal assistants, and the heads of

1. Read before the National Telephone Exchange Association, Detroit, September 9, 1890.



Schemes of Corporate and Departmental Organization for Telephone Service.

the departments, for the same reason which makes it necessary for him to control all appointments makes it necessary that—following the line of authority and, conversely, of responsibility—each other officer should, so far as possible, hire and discharge all for whose efficiency he is immediately responsible.

Just here I want to point out the error into which all of us who have charge of a number of men are apt to fall. That is, of doing too much detail work, too much *work* I was about to say ; but it is the quality not the quantity generally at fault. It is often so much easier to do personally than it is to teach others that we fall often, insensibly, into the error of doing routine work which others can do as well, or better ; and having filled our day with arduous labor, go home at night tired but satisfied that the day has been well spent, when, as a matter of fact, we have perhaps lost sight of our duty to keep track of and direct the work of others, and have performed the work of a junior clerk while the interests committed to our charge have suffered in all directions from neglect.

The functions of the Construction and Operating Departments with their various sub-divisions are so well understood by all that it is unnecessary to go into details, and we will follow quickly along the line of authority through the office of the general superintendent to the linemen on one side and on the other to the operator and messengers.

Now to pass on one point of the diagram to another, we must follow back and around on the established lines. There must be no cross lines of authority established, or immediately there is a division of responsibility. This does not mean that there are to be no direct relations between officers and departments except over the route of lines of authority. On the contrary, as I have already said, there must be almost innumerable "lines of relation." These lines may be established in two ways. First, by order of some common superior authority, and second, by an understanding between the employés concerned.

For instance, by order of the president the treasurer might be authorized to use office managers to collect certain accounts or pay certain bills. The treasurer would then have a line of direct relation established with each office manager, but the authority would originate with the president, and his order would pass through the hands of the general manager, general superintendent and superintendent of exchanges to the office managers. Authority given to the treasurer to employ the managers would always be given with the tacit or expressed understanding that the regular duties of the employé called on should not be interfered with, and that the employé's first duty was in every case to his immediate superior.

As an instance of the second sort, it might be arranged between the Construction Department and the Equipment Department that one would do certain things in connection with the other's work ; for example, that the Equipment Department would hang a cable which the Construction Department was responsible for hanging. The test of this transaction would come in case of failure to carry out this understanding. Would it be any excuse for the Superintendent of Construction to say that the Superintendent of Equipment had promised to hang the cable, and had failed to do it ? Clearly not. The diagram shows how such an arrangement could have been made by authority. He took the chances of an arrangement under which he had no control over the other party, and he accepted all the responsibility. In a bad organization this constant shifting of responsibility is always found, and the blame should be with the organizers rather than with the employés, who are probably doing the best they can with the faulty system.

Another fault always found in a bad organization is a defective method of giving orders. Sometimes an organization that otherwise would be good, is demoralized in its work by a careless habit of giving vague verbal orders, a practice sure to result in confusion. Whenever practicable, orders should be given in writing ; they should be brief and clear, and whatever is to be left to the discretion of a person carrying out an order should, if possible, be so stated. Advice and suggestions may be verbal, and often are better so. When an order is accompanied by advice or suggestions as to methods, care should be taken to so separate the order and the suggestions that there may be no misunderstanding.

When verbal orders of any importance are received by any employé he should take the earliest opportunity to reduce them to writing and send an acknowledgment of them, explaining his understanding of their nature, to the officer from whom they were received.

The chart which I have made shows substantially the general organization of a large company, but one which operates a comparatively small territory. Of course a chart prepared for one telephone company or exchange would not be suitable for all others, or, perhaps, for any other; but there are certain functions which are common to all and modifications can easily be made to fit all conditions.

The key note of all successful organizations is sounded in the Bible words : "No man can serve two masters." In the abstract we doubtless all agree with this, but in practice we often make discord instead of harmony among the delicate strings which bind our forces together. It is easy to say that we all arrange our forces so that no man shall serve two masters, but it is far from easy to do it. Especially is it difficult in a small company, where the number of men must necessarily be limited, but where the manifold duties of the service must still all be performed. Even in the larger organizations it is far easier to cross and tangle the lines than it is to keep them straight. The diagram system will aid the manager of a small company to arrange his men to advantage, while to the manager of a large company it will act like the "deadly parallel column" in the newspaper, pointing out all inconsistencies between theory and practice.

Our work of organization and administration is, under the most favorable conditions, perplexing and difficult. Lines must be built, offices equipped, apparatus designed and constructed, records kept, rights of way obtained, reports made, supplies purchased and taken care of, problems legal, financial, scientific and practical solved, and withal we must reckon with human nature in all its varied forms. Each unit of the vast aggregation must be placed where it will be most beneficial to the whole and yet each be so dealt with that personal pride and self-interest shall be considered, faithful service and capacity duly rewarded, the ignorant educated, the idle punished, the vicious and incapable eliminated, and over all discipline, tempered with sympathy and kindness, maintained. Only a thorough organization, wisely administered, can accomplish all this. Without organization the ablest will fail and with it the best will often fall far short of their ideal.

When we have constructed our "artificial person" from drawings which clearly show the location and relations of all the parts, and from specifications which define in exact language the function of each, it may still lack much of the perfection of the natural person, but I am sure it will do its work with far more efficiency and vastly less disturbance than if it be simply an aggregation of unrelated parts tangled together by the old-fashioned "rule of thumb" method.

THE HOUSING AND CARE OF CENTRAL OFFICE APPARATUS.[1]

BY W. R. PATTERSON.

THE cost of the apparatus in a large central office is often greater than the cost of the building which contains it ; at the least, it is equal to a very considerable fraction of the cost of the building.

In renting an operating room for a short term there may be some excuse for taking things as they are found, and working the exchange at a disadvantage in some particulars ; but when a special building is to be erected, nominally as a telephone exchange building, it must be something more than an office building, with the most undesirable part grudgingly spared for an operating room. An outside income from rental of offices and stores is a good thing, unless it is secured at the expense of the legitimate business of the company. The switching apparatus of an exchange system is not a lot of separate instruments, like the outfit of a telegraph office, but it is a complex entity which requires weeks or months to put in position, and the parts of which are not easily renewable or accessible. Therefore, in planning the construction of a building, the fact must not be lost sight of that it is a telephone building, and that its purpose is to protect the central office apparatus and facilitate economical and satisfactory service.

In planning a new building the company's electrician is to be consulted before the architect. The electrician's duty is to plan a switch-board room with reference to the best possible arrangement of the board and all the apparatus connected therewith, having as the only limitation the size and shape of the building lot. The process of evolution of the building must be :—First, the switch-board with its accessories ; second, the finished rooms to contain them ; third, the building of which these rooms form a part. At the third stage, and not till then, except as a consulting engineer, should the architect be called in. Give him the building lot and the finished operating room and its complete equipment as his limitations, and then let him do the best he can with the building.

As to the location of the operating room in the building, precedent is for the top floor. When all the wires were on poles and housetops, the most convenient place for the switch-board was at the top of the building. The use of underground wires is almost universal, at least for leading in from neighboring poles, and this would suggest that a more advantageous place might be found in the lower part of the building. It is impracticable to lay down any hard and fast law, but it would seem that the use of the first or second floor for an operating room was worth considering. Financially, the problem is whether the rental value of the top story, plus the rental value of the space occupied in each story by the cables leading in, plus the interest and depreciation on such cables, is greater, or less, than the rental value of the first or sec-

1. A paper read before the National Telephone Exchange Association, Detroit, Sept. 10, 1890.

ond floor. In the case of a building covering an entire lot, the advantages of an operating room on a lower floor are not so obvious but in a large building, where an interior or rear court is left for light, the operating room may economically be placed on the second floor; building up the court two stories, instead of one, and using the rear of the basement and first floors for storage—so that, for example, the room taken for the exchange room would be in the rear of the second story as against the whole of the top story. Of course, this is only an illustration of what might be done in one case. Electrically, everything is in favor of an operating room near the ground, when, as is the general practice, underground cables are used. One or two hundred feet of cable, made a permanent part of every circuit, is in itself of no importance; but in large cities the amount of cable absolutely required elsewhere, and the possibilities of long distance work with connections into and through other cities, make it important to cut the amount of cable down to what must be used.

All these things, and many others which local conditions impose, being considered, and the operating room planned and its position in the building determined, the next points for consideration are:—Getting the switch-board and other apparatus into the room; connecting the switch-board with the underground conduits; heating, lighting and ventilating the operating room, and protecting it and its contents from fire.

Providing means for getting in and out with apparatus must be considered. In making plans, the best way is to project into space the switch-board, then project around it an operating-room, and then fill in the rest with the best arrangement of rooms and offices. But in building, the process must be reversed—first, the building, then finish the operating-room, and last of all put in its furniture.

Dragging switch-board sections into an unfinished building through a window or a hole left in the wall is poor policy. While the ultimate end of any machine is the junk shop, a piece of work like a switch-board makes more progress towards that end in a few weeks in an unfinished building than in years of service.

Provision must be made for getting cables from the street conduit to the switch-board. The position of the building relative to the conduit, and the number of cables to be accommodated, will determine the best way of getting from the conduit into the building. In general, a tunnel accessible throughout its whole length is best. If the cables are to be taken up through the building to an operating room on the top floor, there are several ways of getting them there. One is through ducts built in the wall; another through pipes fastened to the walls, either inside or outside; another is through a shaft or well-hole in which the cables are accessible. Whichever plan is adopted it should be carried out in such a way that cables of as good specifications as the regular underground cables can be used. In general, the shaft is the best plan, then the pipes on the walls, and least satisfactory, the system of small flues in the walls. The shaft is of advantage, not only in handling cables, but also as a ventilator for the conduit. A good plan for a large exchange, to require a hundred or more cables, is a straight tunnel or passage-way through the building from the conduit in the street to a point under the cable terminal room. From the inner end of this tunnel a straight shaft may be carried through the roof with provision made for clamping the cables upon the sides at short distances, and with a stairway or an elevator in the centre; the cables to run continuously from the street to a terminal room adjacent to and practically a part of the switch-board room. If the operating-room is on the lower floor the large shaft through the roof will be unnecessary—provision being made for a shaft or flue large enough to ventilate the conduit, either by natural draft or by a fan.

Now, as to the construction of the operating-room itself with reference to lighting, heating, ventilating and fire-proofing: First, let us consider the contents of the room. The apparatus therein forms a part of every circuit, and every conversation passes through it. The time is rapidly approaching when all the circuits will be metallic—that is, a circuit will be no longer a single wire, but two sides which must be balanced within a very small limit—balanced not only in resistance but in capacity and insulation. Then, there are spring jacks and keys, contact points, numbering in the aggregate into the hundreds of thousands, poor contact in any one of which will cause poor service on some line. The surfaces on which the springs and contacts are mounted, and to a greater or less extent the insulating material of the thousands of miles of wire used in connections, are hygroscopic, and the insulation of this part of the circuit rapidly falls with the increase of moisture in suspension in the air. A particle of dust under a contact spring either opens the line entirely or throws in more resistance than the whole circuit should have. The extension of underground telephone circuits, the increase of electric light and motor lines, and the continued demand for better service—all require that better work shall be done in the switch-board room than was even suggested a few years ago. This being the case, more thought must be given in the future to the heating, ventilating and care of such a room than they have received in the past. Instead of letting this matter rest and provision be made for heating as a sort of afterthought after the building is planned, and no provision made for ventilating except by open windows and doors, it must be one of the first to receive attention. The heating and ventilating of the operating room must be planned together. Windows and doors as a means of ventilation must be ignored, and windows only used for light. Heating should be by a system of indirect radiation, and the air must be at all seasons of the year of uniform dryness and freed from dust. The coils for heating the air in the winter may be used for cooling it in the summer, circulating cold water or a freezing mixture through them instead of steam. The electrical and mechanical engineer must furnish the detailed plans and specifications for this work, and the architect must accept them, together with the switch-board room and cable conduit, as the things around which the building is to be erected.

When windows are used for ventilation good service cannot be expected. In a city where soft coal is burned, the soot is a cause of high resistance if deposited on the contacts, and making contacts of platinum will not remove it because the separation of the surfaces is a mechanical one and is not due to surface corrosion. This soot is much worse than street dust, since it is adhesive, and the continued closing of contact springs tamps it down on the surface so that only a file or scraper will remove it. On account of its adhesiveness putting contacts vertically will not cure all the trouble, for the reason that the particles of soot will not fall off. Smoke from hard coal is less objectionable, but even this causes corrosion of contact surfaces and renders the use of platinum necessary. Apart from these electrical difficulties caused by dust, its presence, more especially gritty street dust, in the room, causes the rapid wear of cams, plungers, and other parts of the apparatus which require to have a motion which can be affected by friction. A switch-board set so that a draft of smoky or dusty air passes through will arrest a great part of the ponderable particles. The principle of dust arresters used in pipes from saw mills, grinding rooms, and the like, is that the current of dust-laden air has its direction suddenly changed. The inertia of the particles preventing them from changing their direction promptly, they are left, while the air pursues a tortuous course and escapes. The springs and wires act in just this way on a current of air driven through the board. Enclosing the back of the board is good as far as it goes; but it is not enough. It is much easier to keep dirt out of the room than to keep it out of the board when freely admitted into the room.

In cities exposed to frequent fogs, especially along the coast, the insulation of the apparatus will run very low at times, and the deposition of salt on the surfaces makes them more hygroscopic and tends to increase the escape. The only insulating material suitable for most of the switch-board work is vulcanite or hard rubber. This is a vulcanized compound and a continual moistening and drying of its surface results in the oxidization of sulphur to form sulphuric acid. Both these causes result in a permanent lowering of the insulation.

The regulation of the amount of moisture in the air, and its removal above a hurtful limit, has also a direct bearing on the fire-proofing of the board. Of necessity, a great mass of insulated wires must be used to connect key-tables and jacks. The spring-jack connections can, to a great extent, be cabled, and by this means made less inflammable, but the key-boards must be wired with loose wires. There is no insulating material available so far that it is both moisture-proof and fire-proof. Fire-proof qualities are generally made secondary to water-proof qualities, and so the under and back sides of the boards are covered with an inflammable mass of paraffine, beeswax or rubber covered wire. If hurtful amounts of moisture can be kept out of the room the problem of fire-proofing is solved, because dry cotton or silk can be used for the insulation of the wires. A wire closely covered with dry cotton is as near fire-proof as it can be made, and the only objection to be brought against its use is its hygroscopic nature and the consequent low insulation resulting from moisture absorbed from the air.

Precautions having thus been taken to prevent the ingress of dust and moisture with the air, the room should also be constructed with reference to its care and with a view to confining to a minimum the production of dust and dirt within the room. A tile floor, or, at least, one of well-finished hard wood, will assist in this, and the janitor must have learned his trade in a picture gallery rather than on a canal boat. Battery and repair rooms must be entirely disconnected from the switch-board and cable rooms and the operators coming in from muddy streets should not go into the switch-board room to reach their dressing room. Dust-collecting-and-producing carpets, rugs and hangings must be omitted from the furniture, and it may be that sometime the operators will be required to dress in the least dust and lint producing fabrics. Before that time, however, the manufacturers will be expected to produce a cord that will not fray out and add its contribution to the dust.

It may seem that too much importance has been attached to such little things as a regulation of moisture to within a small percentage, and removing dust. But all the precautions advised are no more insignificant than have to be observed in some branches of manufacture, notably the spinning of fine cotton. The telephone itself is made up of little things. The little things in connection with circuit construction, cable work, strong cur-

rent protectors and line tests, have been worked out to a greater or less extent, and no step has been so small as not to show an improvement in the result. The next advance is to be in the proper care of the switching apparatus, and in the construction of exchange buildings, mainly with a view to the protection of the apparatus.

Now, having decided upon the position of the room in the building, your electrical engineer having laid out the floor plan of board and cable room, your heating engineer having provided ducts and rooms for admitting and treating the air, you are ready for the architect. You will have projected into space the rooms devoted to exchange work, and the connection of these rooms with the street conduits, and the complete heating and ventilating plant attached. This is turned over to the architect. He may not be able with these limitations to introduce all the artistic features he would desire in the front, he may not be able to plan such desirable suites of offices as he would, if left to his own devices, he may not be able to plan stores more desirable to tenants than anything else in the neighborhood; but you will have an exchange room which is not an after-thought and which is not the leavings of everything else. In such a room the life of the apparatus will be prolonged, and if originally well constructed it can be depended upon to give uniformly good service.

There may be exchanges working under exceptionably favorable conditions of climate and surroundings where all these precautions would seem unnecessary, but none of them are very expensive and none of them could do any harm.

In existing buildings, where the record of troubles shows a preponderance of open contacts and where frequent cleaning of contact points is found necessary, it would undoubtedly pay to introduce the heating and ventilating plan above recommended. An indirect radiation system of heating is fully as cheap as any other, the only additional expense being the running of the apparatus for ventilation when artificial heat is not required. This expense would not be worth considering if all trouble from open and high resistance contacts could be avoided. That it can be, there is no reason to doubt. If the dirt is kept out of the room it cannot get into the board; if moisture is kept out of the room, it cannot get into the insulation of the wires. Dirt can be kept out of the room and the degree of moisture be regulated just as well in a switchboard room as in a theatre, library or spinning room.

SOME GENERAL REMARKS ON TELEPHONE EXCHANGE CONSTRUCTION AND EQUIPMENT.[1]

BY F. A. PICKERNELL.

THE modern telephone exchange building should be thoroughly fire-proof. False floors and concealed masses of wires should be avoided; for a fire once started in such places is extinguished with great difficulty. In its erection, everything should be sacrificed that in any way interferes with the particular object for which it is built.

In the basement, racks are to be provided for underground cables. Between the basement and terminal room a cable shaft or system of ducts is to be constructed.

On the top floor are to be located the operating, terminal battery and power, cloak and lunch rooms. These rooms should be provided with chemical fire extinguishers, and the manager, fire chief and assistants thoroughly instructed in their use.

In case of fire every effort should be made to suppress it without calling on the Fire Department. If the fire should attain considerable proportions, it could at its worst only consume all the combustible matter in the room, for inasmuch as the operating room is on the top floor, the fire could not cripple any of the supporting columns or beams of the building and cause it to fall. If a small fire were started and the average fireman admitted, he would do more damage with his axe and hose than the fire would in entirely consuming the apparatus.

Before a telephone company is in a position to erect a suitable building it is necessary to make definite estimates of the probable extent of the underground work, the ultimate number of subscribers it will be desired to handle at the proposed exchange, the probable number of trunks to other exchanges, the probable number of extra-territorial lines, the amount of private wire business, the probable average number of calls per subscriber, per day, when the switch-board attains its ultimate capacity. A careful estimate of this kind determines the ultimate capacity of the switch-boards, underground cable runs, etc., and consequently fixes the minimum size of the building.

In order that the building may fulfill the requirements of a modern telephone exchange, a technical expert should be provided with these estimates and his opinion taken before any land is purchased or building erected. He should co-laborate with the architect in making the building plans. Mistakes have already been made by telephone companies in adopting plans of good office buildings and afterwards placing the switch-board wherever room could be found. Such buildings have been found unsuitable for modern telephone exchanges. It does not follow from this that the requirements of a good telephone building are necessarily incompatible with the demands of an office building.

One of the first matters to be considered in planning the building is the handling of the underground cables. The system for bringing in the cables should be thoroughly flexible and permit of the drawing in and out of any particular cable when the point of ultimate equipment is reached. The cables are to be extended through the basement to vertical rows of ducts or to a suitable cable shaft, extending to the cable terminal room. The massing of the cables in rows of ducts extending to two in number should be avoided. Wherever it is necessary to pass from one system of ducts to another system, the cables should be brought into a vertical row, thus rendering each cable accessible.

Before any building plan is adopted, a complete working plan for the handling of the underground cable should be made. This working plan would show the exact location of every cable in the subway, at each turn, and the location of its inside terminal.

It is preferable to head up cables in a terminal containing a sneak current and lightning arrester. The sneak current arrester should operate with the current of .3 of an ampere in 40 seconds, and the lightning arrester should operate when the potential of the wire rises to 300 volts. By using a combined cable head and strong current arrester, economy in space as well as in expense is insured. The strong current arrester should be so designed that the lines can be tested at this point, by using suitable plugs.

The terminal room should also contain a distributing board and chief inspector's desk. The most economical, compact and flexible distributing board that has yet been devised, is that known as the "Hibbard Iron Distributing Board." The cable terminals should be connected with the line side of the distributing board by flexible cable, all connections being solid. The switch-board cables terminate on its other side. For cross-connecting wires, okonite wire No. 20 B. & S. gauge, insulated to $\frac{1}{16}$ of an inch, twisted in pairs, should be used, all connections being solid.

The chief inspectors' desk should be located immediately in front of the distributing board and should be provided with a telephone outfit, Morse key and relay, Wheatstone bridge and galvanometer and loops extending to the tower and battery room, local switchboard and chief operator's desk. It should be provided with testing plugs for use at the strong current arrester.

Near the terminal room should be located a power and battery room, and in this room battery racks should be provided upon which the operators' transmitter batteries and chief inspector's testing batteries can be located. The battery rack should be wired with water proof wire in a permanent manner.

In this room a generator switch-board should be provided, and have terminating upon it loops to the various portions of the multiple board and also the terminals of all generators. Electric motors, water motors, or other suitable power supply, should be located here. Both the terminal room and battery and power room should be so located that it will be possible to enter them without passing through the operating room.

On the same floor and adjacent to the terminal room should be located the operating room. This room should be large and well ventilated, free from elevator shafts, columns or other obstructions. The switch-board should commence at the end of the operating room nearest the terminal room and extend from it in a straight line.

If it becomes necessary to deflect the switch-board from a straight line, it should be arranged so that the operators sit on the inside of the curve. This enables the chief operator's desk to be so located that all parts of the switch-board are visible from this point. The size of the room necessary will depend upon the ultimate capacity of the switch-board. If the switch-board is to have an ultimate capacity of 4,000 lines or over, the extra-territorial trunk section should be the first in the system. It should be equipped with five point spring jacks and three point plugs, so that when a line is in use at the trunk section, it tests busy at the other boards.

If a switch-board is to have a capacity of less than 4,000 lines, the trunk board should be made the last section in the system, and the regular Chicago spring jack used. The reason for locating it last in the system is as follows: Whenever a metallic circuit connection is made at any section, an open leg is attached, which extends throughout the rest of the board, to the answering jack. The open leg is shortest on connections made at the last section. In large boards, this introduces an appreciable amount of cross-talk. By making the trunk line section the last section in the board, all connections made at this board have a minimum length of open leg and consequently the switch-board cross-talk is reduced to a minimum.

The answering jack should be the the last spring jack in the system, thus insuring, in every connection, at least, one of the parties connected having no open leg attached to his circuit. If the answering jack were the first spring jack in the section, every connection would have at least one open leg attached to it extending throughout the whole system.

Next to the trunk section comes the regular multiple board, the number of sections depending upon its present equipment.

1. A paper read before the National Telephone Exchange Association, Detroit, September 10, 1890.

It has been found that sections of multiple board six panels wide, of the hog-trough type, and having an ultimate capacity for 800 subscribers' drops, is the most desirable form of multiple switch-board. On the back of the hog-trough is to be located tubular clearing-out drops and tubular subscribers' drops.

Immediately back of the hog-trough is to be located a cord shelf, upon which both cords are to be placed. In the face of the board, immediately above the cord shelf, is to be placed the answering jacks; above the answering jacks, the subscribers' jacks.

The standard condenser, listening and long-distance ringing keys, with talking contacts of platinum, have been found to give most excellent service. On the frame work, immediately under, and back of, the cord shelf, is to be located an intermediate distributing board. It has been found that it is possible to so distribute the busy subscribers with those that are not so busy, as to make approximately equal the work for all the operators. In order to do this, without changing the number of the subscriber, the intermediate distributing board has been designed. One side of this board is connected to the answering jack and subscriber's drop, and the other side to the cables coming from the multiple board.

By placing two numbers on the subscriber's drop, one on the shutter corresponding with the answering jack, and one on the face plate corresponding with the spring jack number in the multiple board, it is possible to make cross connections at the intermediate distributing board and not change the drop number of the subscriber.

A change of this kind will be effected as follows:—Suppose that the operator upon which subscriber No. 654 terminates, was very busy, and that the operator upon which subscriber No. 235 terminates, was not so busy; and also that the subscriber No. 654 was a very busy wire, and subscriber No. 235 was not a busy wire, it would be desirable to interchange the answering jacks of these two subscribers, for, by so doing, the work of the operators would be more equally divided. This would be done at the intermediate distributing board by cross-connecting the two answering jacks and by changing the face plates on these two subscribers' drops. The office record of circuits should be so constituted as to admit of this dual numbering of drops.

The double trunk system for intercommunication between offices is recommended. Push buttons connecting local operators with the talking circuits are to be placed within easy reach in front of each operator. All incoming trunks should terminate on single cords and be operated by a call wire system. For this purpose the incoming trunk line operator has his head telephone included in the talking circuit from the other exchanges. The trunk circuits should be arranged so that if the calling wire breaks down any other trunk line may be quickly substituted and pending the change the trunk lines operated by drops.

It is also desirable to have the circuits so constructed that when the operator at the originating office disconnects a trunk line, the operator at the receiving office is notified automatically by special signal. This reduces the number of calls on the talking circuit one-half.

In front of the switch-board, in such a position that all sections may be easily seen, a monitor desk should be placed. This desk should have terminating on spring jacks, loops extending to each operator, to the chief inspector's desk, and to circuits in the multiple board.

All operating rooms should be laid with linoleum to prevent noise by people walking about. On the same floor as the operating room a cloak room and lunch room should be provided. The lunch room should be equipped with tea and coffee urns, lunch table, etc. By providing such conveniences for the operators, a better class of women become available and exchange service correspondingly improved.

In closing these remarks, I would call attention to the necessity of providing complete working plans and specifications of the proposed equipment including the cable run before the construction of the building is commenced. Extensive alterations in buildings and apparatus already made in several of our central offices, would not have been necessary had this been done. Such plans are necessary to the successful and economical erection of a modern telephone exchange, as are the plans for the erection of a suspension bridge, or other engineering work.

THE TWELFTH MEETING OF THE NATIONAL TELEPHONE EXCHANGE ASSOCIATION, DETROIT, MICH., SEPT. 9, 10, AND 11, 1890.

The Association was called to order at the Russell House, Detroit, by President W. D. Sargent. The following were in attendance:—

Albany, N. Y.—A. B. Uline.
Atlanta, Ga.—W. J. C. Cole.
Austin, Texas.—F. B. Knight.
Boston, Mass.—I. H. Farnham, W. A. Hovey, H. V. Hayes, J. N. Keller, Thomas D. Lockwood, A. O. Morgan.
Bridgeport, Conn.—Charles B. Doolittle.
Brooklyn, N. Y.—W. D. Sargent.
Buffalo, N. Y.—E. J. Hall, Sr., H. C. Palmer.
Chicago, Ill—E. M. Barton, F. G. Beach, W. Forman Collins, E. D. Crandall, F. E. Degenhardt, Fred DeLand, Mr. Dickerson, Mr. Durburrow, C. E. Mosely, E. L. Powers, Gilbert M. Smith, C. H. Wilson.
Cincinnati, O.—E. V. Cherry, G. G. Hall.
Cleveland, O.—J. P. McKinstry.
Columbus, O.—J. E. Zeublin.
Detroit, Mich.—Paul W. Bossart, F. A. Forbes, W. A. Jackson, J. F. Lerrell, Louis A. Palmer, Frank B. Rae, R. B. Watson.
Elmira, N. Y.—W. N. Eastabrook.
Kansas City, Mo.—Charles W. McDaniels, J. O. Stockwell.
Louisville, Ky.—Capt. H. N. Gifford.
Milwaukee, Wis.—John D. McCleod.
Nashville, Tenn.—O. F. Noel.
New York.—C. O. Baker, Jr., Gen. C. H. Barney, L. D. Beck, W. A. Childs, D. I. Carson, J. J. Carty, J. F. Cummings, Arthur J. Fuller, E. J. Hall, Jr., G. A. Hamilton, A. S. Hibbard, James F. Kelly, F. A. Magee, George T. Manson, J. P. McQuaide, F. E. Pickernell, C. W. Price, Frank W. Price, Henry D. Satnley, C. E. Stump, Thomas R. Taltavall, W. B. Thayer, Jean A. Wetmore.
New Orleans, La.—A. W. Crandell.
Omaha, Neb.—C. E. Yost.
Philadelphia, Pa.—H. S. Huidekoper, E. A. Westbrook.
Salt Lake City, Utah.—D. S. Murray, George Y. Wallace.
Washington, D. C.—J. M. Brown.
Williamsport, Pa.—R. Bailey.

The ladies attending the Convention were as follows:—

Mrs. C. H. Barney, Mrs. W. J. C. Cole, Mrs. A. W. Crandell, Mrs. W. N. Eastabrook, Miss Gifford, Mrs. J. B. McKinstry, Mrs. J. P. McQuade, Mrs. H. C. Palmer.

The calling of the roll showed that there were represented twenty-six active members, three associate members, and six honorary members.

The secretary read his report as follows:

SECRETARY'S REPORT.

I have the honor respectfully to submit my report of this Association for the year ending August 31st, 1890.

At the beginning of the Association year the roll contained the names of 34 active, 6 associate, and 27 honorary members. The changes during the year have been as follows: At the Minneapolis meeting the resignation of the Sunset Telephone Telegraph Company, of San Francisco, as an active member, and of Clark B. Hotchkiss as an associate member, were both accepted, and the Callender Insulating and Water-proofing Company was dropped from the roll of honorary members, it having gone out of business. At the same meeting, the Cumberland Telephone and Telegraph Company was re-elected to active membership, and Messrs. Felten and Guilleaume, of Cologne, Germany, were elected as associate members. Mr. A. G. Day, an honorary member, has died during the year.

These changes leave us with a membership at the close of the Association year, as follows: Active, 34; associate, 6; honorary, 25.

There is now in my hands, to be presented to the Association, the resignation of the City and Suburban Telegraph Association, of Cincinnati, as an active member, and that of J. A. Roebling's Sons' Company, of New York City, as an associate member.

The office of the secretary has remained at 510 West 23d street, New York City, during the entire year. The usual number of inquiries for information have been received and replied to, and the *News Letter* has been regularly issued, semi-monthly, until January 1, 1890, and monthly since that date. The treasurer's report will show that the income of the Association has, during the past year, considerably exceeded its expenses, by reason of a deduction in the latter. There is now in the treasury a balance of $320.99 as against $66.41 at the beginning of the year. All accounts due the Association have been collected, and all debts of the Association have been paid to the end of the fiscal year.

The income of the year was derived as follows:

From annual dues	$1,950.00
From initiation fees	10.00
From sales of extra copies of proceedings,	49.15
Total	$2,009.15

The expenses have been distributed as follows:

For salary of secretary	$1,000.00
For printing proceedings, Minneapolis meeting	245.25
For other printing, *News Letter*, circulars and blanks	129.40
For office expenses, stationary, postage, telegrams, express and newspaper clippings	98.06
For stenographer at Minneapolis meeting,	136.50
For other expenses at Minneapolis meeting,	145.36
	$1,754.57

C. H. Barney, *Secretary.*

On motion the report was accepted and placed on file.

The treasurer's report showed a balance of $320.99.

PRESIDENT'S ADDRESS.

Before nominations are made I will ask the indulgence of the Association to listen to a few remarks that appear to be pertinent to the occasion of the Tenth Anniversary of the Association. On the 7th of September, just ten years ago, the first convention of telephone men assembled at Niagara Falls. The meeting was the result of a circular sent out some time beforehand, signed by representatives of the leading telephone companies in the United States. The object of the convention, as stated in the circular, was, "the formation of a general telephone association to consider the various questions affecting the telephone business and its developments." This meeting was organized by the election of George F. Durant, as chairman, and E. J. Hall, Jr., as secretary. The roll of representatives showed 86 individuals, representing various companies, 6 representatives of the American Bell Telephone Co. and 21 representatives of manufacturing interests; making a total of 113 individuals. A constitution and by-laws were offered, and various reports and papers were listened to and discussed, after which the convention, on the morning of September 9th, adjourned *sine die.* Immediately following this adjournment, and on the same day of which this is the anniversary, the first meeting of the National Telephone Exchange Association of the United States assembled. The present constitution and by-laws were adopted, and the following officers elected; President, Geo. L. Phillips; vice-president, H. H. Eldred; secretary, M. F. Tyler; treasurer, D. I. Carson. The Association then adjourned to meet in Chicago on the first Tuesday in April. The subsequent meetings in Saratoga, Boston, Cincinnati, Philadelphia, and so forth, are a part of the history of our business.

Of the original members, many have left the business, and a few—but all too many—have been taken away by death, notably our universally esteemed first president, George L. Phillips, and others no less dear, and of whom the Association has expressed its appreciation in just and loving tributes to their merits.

Ten years ago how crude the business was! The multiple switch-board was a mere idea; tables were only hinted at; the use of iron or steel wires was almost universal. Insulation was considered of little account by many, and some declared insulators superfluous (laughter), the value of the service was underrated by the public, and our own standards were far below those of to-day. The highest efficiency and reliability is what the public demand of us, and business and prosperity will follow us just as fast as we are able to meet that demand. The standard of to-day requires the use of copper for conductors, overhead as well as underground, and the substitution of metallic circuits for single grounded wires. The underground wires and cables of five years ago do not answer the requirements of to-day, and the same may be said of central office and subscribers' equipments. With improved service comes increased use by the public, and the ability and energies of the best minds in the business may well be taxed to the utmost to keep up with the demand.

This Association has in the past been active in the development and extension of new ideas and improved methods, and it is, therefore, with regret that I call your attention to the lack of interest and the falling off in membership during the past three or four years. The City and Suburban Telephone and Telegraph Co., of Cincinnati, have resigned, and the active membership is now only 83. The secretary's request for papers to be read at this meeting met with no response. The papers which we have were procured by personal solicitation on the part of the officers. It may be said, indeed, that outside of the secretary's statistical report, the furnishing of papers to serve as topics for discussion during the last few years has been done by a very few individuals. If the Association is to be of service in the future, its members generally must take a more active part in the preparation of the papers and reports which form the basis for our discussions. In conclusion, I desire to thank the Association for the kindly manner in which they have treated an inexperienced presiding officer. (Applause.)

The following officers were elected for the ensuing year:—President, W. D. Sargent; vice-president, F. G. Beach; treasurer, H. L. Storke; as member of the advisory committee, vice Capt. Stone, resigned, W. A. Crandall; member of advisory committe for three years, W. A Jackson; executive committee, E. J. Hall, Sr., C. T. Cutter, C. H. Wilson, H. N. Gifford.

The paper on "The Operation of the Double Cord Key Board at Brooklyn, N. Y.",[1] by Mr. Davison, was then read by Mr. J.J.Carty.

In the discussion which followed, Mr. T. D. Lockwood remarked that this was one of the most practical papers that had ever been presented before the Association. Some two years ago he visited Brooklyn, shortly after the single cord switch-boards were set up there, and was much impressed with the attention which was evidently bestowed upon them. When we consider the calls to be received from the subscribers, and consider also that the operator must ascertain whether any of the lines is already in use, and when we consider that the second subscriber must be called, and that the two lines are then to be united for conversation, and that the conversation must be largely guided and supervised, and that finally the disconnecting appliances are to be supplied, it is not surprising that this organism frequently gets out of order. It required the most constant supervision of any electrical instrument that he knew of, for many reasons. Each line has to pass through a great number of contacts, and necessarily so. The instruments for receiving calls have to deal with currents which are not strong, and which sometimes have to pass over unavoidably leaky lines which cannot at all times be kept in the highest order of repair. He thought that the troubles which appeared were not altogether, either in number or in variety, greater than might have been expected if we stopped to consider what the current was, what we were dealing with and of the very uncertain nature of all machinery, especially when it is worked to such a large extent as is a central office switch-board.

There was one other thing which also impressed Mr. Lockwood, and that was the very great improvement which took place this year in comparison with the year 1889. This, he thought, showed constant supervision.

THE PRESIDENT remarked that while it might seem to members that the paper ended a little abruptly, the facts presented were so obvious to the writer that in making the concluding remark he supposed that everybody would see that the double cord switch-board which he had just described was so far superior to the single cord switch-board that he did not need to put it into words. There was far less trouble with the use of the double cord than with the single cord board. The troubles with the single board switch-board lay in their removal; they usually bring in other trouble and prevent the operator from doing the work properly, and altogether create a great deal of trouble, whereas, with the double cord board all these troubles may be gotten at and removed without interfering in the slightest degree with the efficiency of the operator. He thought the record showed conclusively that the use of the double cord—indeed, the use of a key board that is entirely separate from the wires—was the best.

MR. J. J. CARTY said that much might be said about the merits of the double and the single cord boards, but as far as the work was concerned there were no single cord switch-boards which were adopted for mixed circuits. When an exchange comes to consider the question of a new office, whether a board is adapted to a metallic circuit is the first question, and if it is not so adapted it is usually thrown out.

MR. KELLOGG inquired if there was a single cord switch-board in use in the United States to-day, to which Mr. Lockwood replied that there was one at Columbus.

MR. WILSON also stated that there was a single cord board in operation in Chicago in the main office, arranged for single wires and grounded circuits. They also have a single cord metallic circuit switch-board in operation in the stock yards office in Chicago. It filled all the requirements for metallic circuits, but, as compared with the double cord metallic circuit switch-board, it had not been considered so good on account of mechanical details. They now had in operation in one of their branch offices five different metallic circuit key board systems, with which they were experimenting. The spring jack part of the switch-board is the same in all of them, and, as the different systems dove-tail together, they are able to operate the five different schemes in the same office. They had been doing that for six months or more, and from those five different schemes have adopted one for use in their main office, and the apparatus was now being constructed. But the single board scheme had to give way for one of the double board schemes on account of the advantages of the latter over the former.

Regarding the reference to troubles in the spring jack, they find, in Chicago, where they have long underground circuits, that the introduction of a small amount of resistance in the circuit makes a very great difference in the talk, and it was particularly apparent from their office. If the contacts in the switch-board become dirty—not necessarily open, to interrupt the circuit entirely—they noticed a difference between the incoming and the outgoing talk, and had found that a resistance of 200 or 300 ohms in a contact makes a very appreciable difference in the conversation. Some six months ago they organized a labor force to work every night on contacts through the switch-board and measuring with a galvanometer; if a resistance exceeds 150 ohms, including the drop, which is 100 to 130 ohms, the spring jacks are all cleaned. In that way they keep the service reasonably uniform. Their experience showed that after six months' hard work in cleaning up the contacts they still had on an average from five to ten cases of trouble a day, not including open contacts.

MR. GIFFORD—In regard to this report of trouble, I think that the Brooklyn people ought to be congratulated on the small amount of trouble they have. Our trouble in Louisville is that we have considerable dirty spring jacks. We have a detached building that we occupy in a middle of a square. My wire room and shop is underneath, but I have a floor very heavy, four or five inches thick, and very little dust can get through, and when the janitor sweeps our room he sprinkles sawdust so as to avoid raising the dust; but in spite of all our precautions we do have very dirty spring jacks, and it has been the cause of a great deal of trouble,

1. See page 305.

A subscriber will say that he cannot hear anything, and we first examine the battery. If we don't find anything wrong there then there is a suspicion of a loose joint, or an old iron wire, and we go over those things carefully and if we find any trouble it is removed.

MR. GIFFORD after a long experience considered it was necessary to go through and clean out the whole switch board every month. In his exchange of not quite 2400 subscribers, there are from 25 to 40 broken cords every day, and of course they are a serious cause of difficulty. They had tried the ordinary tinsel and then a combination of tinsel and spiral wire. At last they concluded to have a cord composed of about three times as much tinsel as is ordinarily put in, and that gave a great deal of satisfaction.

MR. A. S. HIBBARD remarked, as a matter of observation in exchanges pretty much all over the country, that the dirty jack trouble is more noticed in places West, where they do not burn hard coal and where the whole atmosphere is permeated with dirt and dust; also, in places where an exchange is located near a railroad yard, where smoke and soot from the engines float in through the windows. He thought it might be possible that that was a reason why they did not have so much trouble with dirty jacks in Brooklyn as they have out in Chicago and Louisville. He thought a feature to which attention should be paid was clean floors.

MR. I. H. FARNHAM remarked that in the new Boston exchange provision had been made against the noise of the listening lever by having the lever strike upon a flexible contact instead of on a solid metal base, with considerable improvement.

In regard to dirty jacks he believed it due both to dirt and corrosion. There was a suggestion made two or three years ago in regard to freeing the switch boards from dust which he thought had not yet been adopted, and that was to case up the switch board on the back and supply a gentle current of air so that it would always be outward through all the crevices of the board, and dust kept out in that way.

MR. WILSON said that the difficulty seems to arise entirely from dust and dirt. The moisture in the atmosphere clings to the spring jacks and the dust more readily adheres. The only relief for that is to have an inverted contact point; that is, inverted in the way it is introduced into the spring jack.

MR. BARTON drew attention to the fact that it does not follow, because in the Brooklyn exchange they had a certain number of troubles with their single cord board, and a certain less number with their two cord board, that the troubles, or absence of troubles, are due to the single cord or the double cord. The fact is that the single cord board which was put in in Brooklyn had key tables in which the apparatus was considerably crude in detail, and the difficulties were very largely due to the crudeness in the detail of that board. Now, if Mr. McKinstry, in his Cleveland single cord board, had as many troubles with the subscriber as they had in Brooklyn, then there would be a chance to make a comparison of the systems, because, between the time when the Brooklyn exchange was equipped, and that of Cleveland, there was a good deal of advancement made in the details of construction. The proper way to reach a clean basis on statistics of trouble would be to compare the present Cleveland board with the present Milwaukee board, or the 38th street, New York board, or the board that has just been opened in Denver. The Cleveland board embodied a pretty good degree of excellence in details of construction. The same degree of excellence has been applied in the single cord boards in use by the German government in Berlin, and those boards he thought were fairly satisfactory. The present tendency of the judgment of the exports in this country was in favor of the two cord key table. He added that there was a considerable number of single cord boards, among others, the principal exchanges in Cleveland, one in Cincinnati, one in Providence, one in Columbus, one in Portland, Ore., one in St. Joseph, Mo., one in Topeka, one in Los Angeles, and in other cities. Those boards were tolerably well liked, he thought, by those who had them.

MR. LOCKWOOD said that he had found another trouble with spring jacks. Some months ago he had occasion to spend a couple of days in Albany, and found that one of the spring jack troubles there was not dirt or carbon between the points, and it struck him that perhaps some of the trouble was due to the fact that the insulated contact screw in the lower part of the jack had been made with such a sharp point that it made a dent in the screw in the spring above, and by-and-by that depression was made so deep that when the foot was taken out it was all that the spring could do to make contact with the screw point at all. This, of course, depended largely upon the material used, and in this case the material was not brass, but German silver, and, as there are different grades of German silver, of course care should be taken to get the proper grade.

THE PRESIDENT said that the opinion they formed by the trial of the two key boards was, that, taking all the conditions of the business, the double cord system was essentially the best; that with the single cord system, doing the best one could with it, it is so crowded and so difficult to remedy trouble that occurs in the midst of busy hours, that that fact alone is enough to condemn it. Mr. Wilson's recommendation of the single cord board was something like that of the cripple who had become very expert with his crutches, which in this case are the double cords, which he used when the single cord failed; but no cripple would be willing to continue the use of his crutches if he could use his legs. He did not think anybody wanted to use a single cord board if they had to have a double auxilliary key board to keep it on its legs.

MR. WILSON did not want to be understood as advocating the one cord system for metallic circuits, because he was not. But if he were going to equip a new office, he would use the one cord system. He used the one cord system altogether for metallic circuits in small exchanges where they have multiple switch boards. The advantages are that they equip the switch boards just as they add subscribers. They had quite a number of subscribers, as, for instance, the Illinois Steel Co., which has its general office in Chicago, with about twenty telephones in use; they have three rolling mills in and about the city, and lines connecting them, and all those lines are run into the private exchange located in their general office, and the company gives them three trunk lines from that switch board into the exchange. A special rate is made for that service, and then the telephones in their general office are connected out in such a way that they have what is called the speaking tupe service, that is, they do not have to call their operator to get service. They were putting in quite a good many of those outfits. The subscriber in such cases as these becomes the company's agent in the transaction of his business, and the deduction they get in rates is the compensation paid them for handling the work. In all those places they used the one cord system, and prefer it to the two cord system. If he were going to equip a large exchange with metallic circuits he would use the two cord system.

The convention then adjourned until 2 o'clock.

AFTERNOON SESSION.

The session was opened by the reading of the paper entitled, "Corporate Organization,"[1] by Mr. E. J. Hall, Jr.

The discussion on the paper was as follows:

MR. E. J. HALL, JR.—While this diagram is applicable to the general organization of a company, I ask Mr. Carty to make a diagram showing how he, in following out this line of thought, has organized the department for which he is responsible in his own company. Starting in at the "Superintendent of Equipment," in the general scheme, he has arranged a diagram of the force which he has under his control, and I think it would be interesting to have him explain how he has utilized this idea before we take up the matter for general discussion.

MR. J. J. CARTY—This diagram on the wall represents one of the departments of the Metropolitan Telephone Company. The Superintendent of Equipment is responsible for the condition of the plant. Any trouble with the wires, cables or apparatus in a subscriber's office, or in a central office, comes from here. The chief inspector has under him, first, a foreman inspector, who gives out the daily work to the inspectors who visit the subscribers' stations. The duty of an inspector is to go to a station and see that it is in order, make a note of what condition he finds it in, and what he has done, and hand to the subscriber a printed slip which has on it a request for the subscriber to inscribe on the back of the slip any fault he may have to find. This foreman inspector has a large detail of men under him, and he is responsible for seeing that his men do their work properly. Then, for taking care of the trouble there is located at each of the various offices, what is called a "wire chief." For instance, at Cortlandt street we have a man who sits at a desk called the "trouble desk," and who is equipped with all the necessary apparatus for locating the trouble. If the trouble at any one of the various stations becomes greater than the ordinary staff can properly take care of, the wire chief at that station communicates with the Chief Inspector, and the detail is increased; or, on the contrary, if he gets his work up in a good shape, he reports that fact and the men are transferred somewhere else. The chief wireman receives from the General Superintendent the orders to put in an instrument for a new subscriber, and that order is turned over to the chief wireman, who gives it to his foreman, and the job is assigned to a particular workman. The chief wireman also sees that the line is cut in at the cable terminal and at the subscriber's station. So that the task of getting the line working is in the hands of one man, and when the line is connected up in working order the chief lineman sends the order back through the Superintendent of Equipment to the General Superintendent, and a record of it is made on the books. When a new subscriber is put in at 38th street, the representative of the equipment department there has got the receipt for information connected with that subscriber. For instance, he has to receive a slip and take a note of the cable conductor that that subscriber occupies, and all the other data necessary to go into the record. So that at 38th street there is a complete record of all the terminals terminating there and all the subscribers, and no change can take place without going through the 38th street wire chief. A similar record is kept at each of the branch offices and a record of the entire city is kept by the Superintendent of Equipment. An arrangement of this kind enables you to keep up

1. See page 306.

records of trouble and compare one office with another, and make some important savings in the number of men at each office.

MR. HALL—I think, perhaps, I could go a little further by reference to the original diagram. Mr. Carty has taken the diagram at a point and has shown what is done by the special division force under his charge. Now, the central thought of all that is this, that in that company one man is responsible for the condition of the line and switch board in the company; there is one man responsible for the physical condition of the property; he has no relation with the operators or with the operating service. That is an entirely separate department, but he is responsible for the operators and the subscribers being furnished with suitable apparatus, and apparatus properly taken care of. That simplifies the problem as to who is responsible for any fault in the service. If the fault is one of apparatus or maintenance, then the superintendent of equipment is to blame. He has nothing to do with the construction of that plant, and he has nothing to do with the operation of it. The question might then be raised that, having nothing to do with the construction of a thing, it might not be properly constructed. That is possible, but his skirts are entirely clear, because all he has to do is to report to the General Superintendent that as a certain thing is constructed it is not possible for him to keep it in proper order. Then he is relieved from blame. The general superintendent may refer the matter to the general manager. It may or may not be possible to correct it. If it cannot be corrected, then the superintendent of equipment simply does the best he can with what is furnished him. If it can be relieved, then it becomes a question for superior authority to give proper instruction. In each of these offices are "detailed operators" and under the office managers are "detailed inspectors." That means that while these men are under the office manager he does not employ them. They are simply placed there for the purpose of receiving information as to what is to be done in their work. Written specifications should be made out defining precisely what the superintendent of equipment is to do.

Then, there is another point. The forms and blanks in use are sometimes defective. Now, we had in one company an expert go through the whole organization from the subscriber's order up to the rendering of the treasurer's bill.

The fault does not lie in having too little routine, but in having too much. The only way to do is to start and organize as if you were beginning a new concern, and then if what you have already here corresponds to that, why, all the better.

There has been a suggestion made that the faults of an organization come generally from those high in authority in it rather than from the subordinates. That is very often so. For instance, the president may have personal knowledge of something wrong and he comes straight across and tells the superintendent of construction that he must do this or that. Now that is fatal to a proper organization. It is something the president should never do except in an extreme case. He ought to notify his general superintendent about it and let the order be transmitted through the proper channel.

On motion, the convention adjourned until 10 A. M. the following day.

SECOND DAY'S PROCEEDINGS.—MORNING SESSION.

The first business taken up was the selection of a place for the next meeting, and on motion of Mr. Eastabrook, New Orleans, was unanimously adopted.

MR. W. R. PATTERSON, of Chicago, then read a paper on "The Housing and Care of Central Office Apparatus."[1]

The discussion on this paper was deferred pending the reading of the paper by Mr. F. A. Pickernell on "Some General Remarks on Telephone Exchange Construction and Equipment,"[2] which followed.

MR. WILSON thought, in the discussion which followed, that the only advantage in having an operating room on the second floor would be in the length of cables, and, as Mr. Patterson had expressed it, the expense of the cables, as compared with the value of the second floor, would be the only consideration. But he thoguht the advantages in favor of ventilation and light, and rendering the operating room more exclusive from outsiders, were in favor of the top floor.

MR. HIBBARD remarked that for many reasons the operating-room should be on the top floor. Besides, the operating-room should be convenient to where the cable is hung up, and where the distributing board is. That was quite a point to be desired in a big local exchange. These constitute three links in the successful working of an exchange. The head of a cable, the distributing-board and its entrance to the multiple-board. If it is possible to hold those three points within the reach of the man who has it all in charge, it is like driving a four-in-hand team—he has a good grasp on the business. If, however, one puts in a terminal point in the basement, and a distributing-board way up in a tower, perhaps, and an exchange board in a third place, these links become disjointed, and as a result the team is apt to go badly.

MR. PICKERNELL remarked that one other objection of having the operating-room on the second floor was the noise because of the close proximity to the street. In Cortlandt street if the operating-room were on the second floor it would be almost impossible to operate it. They had to have three sound-proof booths in the front offices there in order to be able to use the telephone at all.

MR. PATTERSON said he did not intend to advocate the first or second floor locations as against the top floor in all cases. So far as dust and noise is concerned, the lower floors would not be so objectionable if the operating-room were placed in the rear, facing on a court, for instance, and lighted by a skylight from above, and the heating and ventilation taken care of by artificial means.

MR. HIBBARD thought that the putting in of dry air into operating-rooms was of essential importance. Nothing wet should be put in and all dirt and dust should be kept out.

MR. GIFFORD remarked that he had a big skylight in the top of his operating-room, and windows besides. He formerly had the shifting-room for the cables up in a little tower on the third floor, but in the last few months he had taken a room of about 15 x 20 on the first floor, and there the underground system came in. That room is just like a hall; the windows are bricked up, and an electric light is placed in it, and nobody gets into that room except one man and the electrician, and he holds them responsible for everything in there.

MR. CARTY thought that they should so organize their staffs that any number could go in the room. He thought it would be a good thing to have the chief inspector located in that room because then he is near the point where he could do his testing.

MR. HIBBARD hardly favored the idea of having a room locked up in which the protectors were placed. One of the points of having it available and next to the operating-room, is this: The most frequent troubles with the electric light wires are to be expected at night. There has been no arrester put in any exchange which will head of all of these kinds of troubles. Each arrester probably does its work as it has been designed in a particular line, but he did not think they had found any that are good all around. Therefore, if a current comes in, any chief operator who is posted is able at once to go to the seat of the trouble and remedy it.

MR. GIFFORD explained that what he meant was that when the room was perfected and finished he should keep it under the care of just one man and make him responsible for the care of it.

The resignation of Mr. C. E. Bailey, as an honorary member, was then accepted.

MR. J. J. CARTY then gave an explanation of his system of "Bridging Bells."

This is a system of looping, the idea being, when more than one station is connected on a line, to loop the intermediate stations in solid.

A line was built in New York containing eight miles of underground cable and four miles of overhead wire, and ten stations looped in solid, and it was impossible to talk over it. The bridging bells were put on the line and the talking over it now is as nearly perfect as it could be. Metallic circuits are employed.

MR. BAILEY remarked that another advantage in the system which he thought would be available in the future was in the way of giving cheaper telephone service on metallic circuit lines to residences. The chief difficulty that he saw about the system was on long extended lines in the liability to damage by lightning. His company have had for a number of years a similar system in operation on quite a number of lines. They had arrived at it by running a shunt wire, commencing at the first station out from the exchange. This shunt wire is passed in through the station, and the calling wire is looped through.

MR. GIFFORD referred to the fact that where one subscriber can listen to the conversation between the others complaints are apt to arise. For this reason also Mr. Wilson, in Chicago, had decided to place no more than five subscribers on one private line.

He also said that the only objection that he saw to the bridging arrangement on grounded circuits is the difficulty in locating troubles on the lines.

MR. HIBBARD commenced this system of bridging in with two or more subscribers on a line, using first the ordinary bell, which gave, of course, very poor service. Then he put in 500 ohm ringing coils. With that system, and with 500 ohms in the central office, they are getting first-class service with five and six on the line.

MR. CARTY—In regard to lightning, I appreciate Mr. Bailey's position out in the country in having the bells burned out, but I would hate to complicate that bell which has been rendered so simple by putting in any of these devices to get a ground in a circuit point. If there was any other way out of it there might be a bridging designed for that particular use. I think if he tried the most approved arrester he would not have any trouble from burning out. In fact, the trouble he speaks of is not necessarily connected with the bell at all. It is the old question of the transmitter being legged on, and the fact that it is 1,000 ohms does not make it any more delicate than these 500 ohm bell arresters used for bridging. I think lightning jumps across largely because of the thickness of the insulation that is a determining factor in making a discharge. I do not think that the retardation of the coils increases the tendency to jump.

MR. HIBBARD—When bells burn out by lightning it is due a great deal to the mechanical way in which they have been wound.

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1. See page 308. 2. See page 310.

The winding of a magnet of different design has much to do with it. On a long distance line, using a tubular drop, when it was first turned out for us, in 500 ohm drops, we had a good deal of trouble. We found that the wire burned in the outer wrapper generally. That was changed so that the winding was kept away from the iron. No other change was made, and our drops are not burning out as they were before.

MR. CARTY—In some experiments which we made in the development of strong current protectors, it was found that we could make an air cut-out—which is another name for a lightning arrester—and that it would go out at any number of volts at which you wanted to fix it, and they got it down so low that the actual telephone current would jump itself. Now, it seems to me that if Mr. Bailey's bell were equipped with a lightning arrester of that kind it would remedy the difficulty. At least, we should give that a fair trial before we undertake to complicate a bell.

MR. WILSON—We have a metallic circuit from Chicago to Michigan City, about 56 miles. In addition to the two end stations, we have three stations bridged across the circuit. When we first put in that equipment we had great difficulty in locating trouble. We overcame those by simply inserting a little point or switch in the bridge wire. That enabled us to call up the stations and ask them to turn the switch off five or ten minutes, and after they do that we have the old condition of wires without any complication, and that enables us to locate the trouble, whether it is an open line or a grounded line.

MR. CARTY—I might say in regard to the arrangement we have for locating trouble in New York: Everything is getting more and more underground there, and the branches or spurs are necessarily made at the central office. We have arranged for a test-board on the plan of the long distance board with private spring jacks to the board. There will be one of these located in each of our central offices, and the wire chief in charge of the private lines will be located at Cortlandt street. If he finds it is a short circuit he will take off all branches leading from his room, and will then throw them on to a drop and despatch a trouble man on to that branch. If he finds all his own branches are all right, he signals the next office up town, and they have a similar arrangement gone through with until the trouble is located. That can be done in 20 minutes on these complicated lines. We can not only locate the trouble, but get the fault cut off and leave the other part of the circuit working.

MR. WILSON—We are operating all the transmitters in the main office of the Chicago exchange with the Edison current, and we are accomplishing good results. We use storage batteries. We are using at present five cells of storage batteries which have an electromotive force of a little over two volts per cell and give out about five amperes of current. The five cells are connected directly with the Edison current which supplies the office with light, and the storage takes place when we burn the light, and we do not observe any diminution in the lighting throughout the building. There is, therefore, no expense for currrent. The internal resistance of each cell of the storage battery is about .02 ohm. Consequently, as you add transmitters, it simply absorbs more current from the storage battery. The object of having five cells is that it enables us to maintain the storage battery throughout the 24 hours without its becoming exhausted. If we connected all the transmitters, we would necessarily have to turn on light during the day to recharge them. Our experience has shown that with five cells it works entirely automatic. We supply between 60 and 70 transmitters. The arrangement we have contemplates 100 transmitters. We are only operating 60. At the present time we couple about two transmitters, and adjust the resistance until the current in each transmitter is all that it will stand. We also use the Edison current for ringing instead of the small generators.

MR. BAILEY—I have found that the current from all these incandescent plants differs frequently. Where they are supposed to carry 110 they will vary from 90 to 130.

MR. WILSON—The Edison Company have a very large plant in Chicago and they supply motors. The Western Union Company use the Edison current for operating their dynamos, and I think the service gives satisfaction.

MR. GIFFORD—Mr. Forbes uses the same method in the exchange here.

MR. HIBBARD—In watching the generators in the Detroit exchange this morning they had three lamps in the circuit, and you could tell the number of operators ringing at a time by the way the lamps went down and came up and became bright again. He had an electric motor turning the commutator. He had his old equipment for running the ordinary power generator.

MR. WILSON—I would say also that 12 transmitters is the maximum, because the more transmitters you connect on a cell the more current is absorbed from that cell, and you want to adjust the number of transmitters so that the cell will last the 24 hours, or until the lights are turned on again to recharge them. If you are burning lights during the day, with that arrangement it would not be necessary to use so many cells. We propose to have a reserve series of storage cells, and in keeping them stored all the time we will be entirely independent of the source of supply. They will retain the charge indefinitely. I will also add that we are now arranging to take out of the American District plant, which is owned by us in Chicago, the battery which is there—and we now have from 10 to 100 cells of gravity battery located in those offices through the city; and we are arranging to substitute a similar arrangement for all those offices.

MR. BAILEY—The Pennsylvania Railroad Company take current direct from the main at Pittsburgh and Harrisburgh, and use the storage batteries at Altoona. They get very satisfactory current for telegraphic purposes without the intervention of batteries.

THE SECRETARY announced that he had prepared the usual statistical report, compiled from reports furnished by different companies, from the membership of the Association.

After a vote of thanks for the courtesies extended the convention adjourned *sine die.*

After dinner, at 2:30 P. M., Wednesday, the delegates all assembled to take part in a carriage ride and lunch, which had been prepared for their entertainment by the Detroit Telephone Company. Mr. Jackson saw that every one was looked after in good shape and made a prince of hosts. A most enjoyable afternoon was spent, the party first driving around through the beautiful residence part of the city and then out to Belle Isle Park, where a lunch was served at the Casino. After lunch a picture was taken of the group and the whole party then entered their carriages and returned to Detroit.

On Wednesday evening at 8:30 a banquet was held at the Russell House under the auspices, and at the invitation, of The Telephone and Telegraph Construction Company. It was very largely attended by those present at the convention and numerous ladies were present, greatly adding to the charm of the evening, and it went off in a manner worthy of those who had the entertainment in hand. After partaking of the choice menu, the cards of which, by the way, were masterpieces of beauty, speeches and toasts were the order of the evening. President Sargent set the ball rolling with some pertinent remarks, and then called upon Mr. Tyler, of Connecticut, who rose to the occasion and drew a pleasing contrast between the events and progress of the Association from the first meeting until the present. Mr. Crandall, of New Orleans, responded to the toast, "The Ladies," in a truly graceful manner, making a most attractive response. Mr. Thos. D. Lockwood, of Boston, then made some humorous remarks upon a large number of subjects, amongst all of which he was thoroughly at home, and he performed his part, as always, in the very best of shape. Secretary Barney made a short speech full of point, and was followed by Treasurer Storke, who evoked roars of laughter when he related how, during the afternoon drive, Mr. Tyler had been expelled from the Park by the police for walking on the grass and carrying a deadly kodak. Mr. E. J. Hall, Jr., of New York, then addressed the gathering and was followed by Mr. A. S. Hibbard with a song, which was generally acknowledged to be the attraction of the evening. Mr. Hibbard arose, with his neck gracefully adorned with a wreath of smilax, which had been hung about him by his friends near. He then delivered himself of "How I love my Sunday School," in a truly touching and pathetic manner and brought down the house. All the convives joined in the chorus with excellent effect. Messrs. Zeublin, Gifford, Forbes, Vice-President Beach and Joseph E. Lockwood followed in the order named with some interesting speeches. The festivities were finally brought to a close by the singing of "Good Night, Ladies" and "Old Lang Syne," and a most delightful entertainment was at an end.

On Thursday afternoon, at the invitation of the Michigan Bell Telephone Co., a most enjoyable boat ride was taken on the fine steamer "City of Detroit," up the Detroit river through Lake St. Clair and the ship canal through the Flats. Quite a number of ladies were among the party, and as ever, enhanced the pleasures of the trip. An excellent band of music was in attendance. One of the features of the trip was an extempore banjo concert by Mr. A. S. Hibbard, of New York, whose dexterity with the instrument is only equalled by his large repertoire of songs and the spirited manner in which he sings them; in fact he completely paralyzed the regular band for quite a while as he drew the whole crowd on board around him. He was ably assisted by members of the party in the chorus.

Another most attractive feature was room No. 60, where all the male guests received the tip from their obliging hosts to take an observation through the bottom of a tumbler; an invitation which was most cordially accepted. The boat returned to the city at 6:30 p. m. All will carry away with them the lively remembrance of the good time they had in Detroit at the Convention. Too much cannot be said regarding the untiring energy and boundless generosity as kind entertainers of Messrs. W. A. Jackson, T. A. Forbes and J. T. Land, of the Michigan Telephone Co. Throughout the whole duration of the Convention they laid themselves out to cater to the enjoyment of all present.

EXHIBITS AT THE TELEPHONE CONVENTION.

The exhibits made at the Convention were very few but several of the representatives of the prominent supply companies were on hand.

THE NORWICH INSULATED WIRE Co., of 58 Cedar St., New York, exhibited some very handsome samples of their spiral wound paper insulation for telephone cable work. The company was represented by Mr. L. D. Beck, president, and Mr. Jean A. Wetmore, general agent, who explained the peculiar advantages of his cables.

Samples of the regular association standard cable, containing 51 pairs of conductors, both in wet and dry core form, and the cables in different stages of construction, were shown.

This company also have a new method of treating the insulation when employed in telegraph work, which increases the insulation resistance.

They also had a fine display of electric light wires for underground work, either with high or low tension. The paper employed is a fine manilla fibre, which is wound on spirally in reverse layers, ensuring flexibility and centering of the conductor. After being wound on it is compressed by hydraulic pressure and the core is then dried out and finally permitted to absorb a special insulating compound. A large amount of this cable is already in use with the most successful results.

J. H. BUNNELL & Co., of New York, exhibited a number of cells of the Burnley Dry Battery, and were ably represented by Mr. J. J. Ghegan. The advantages of the cell are that it is strong, clean and durable and the connections are so arranged that no creeping salts are developed. It is of very compact form and an interesting experiment of its power was shown by lighting a small 4 candle-power incandescent lamp with four of the cells. It is specially adapted for telephone and open circuit work.

THE NATIONAL CONDUIT MANUFACTURING Co., of New York, had on hand some of their new style telephone conduit, which is made of English Portland cement and crushed granite. Mr. J. P. McQuade had charge of the exhibit and never lost an opportunity of showing up the merits and advantages of this conduit.

THE EDISON GENERAL ELECTRIC Co. were represented by Mr. James F. Kelly, who brought three cells of Edison-Lalande battery with him in behalf of the Edison Manufacturing Co.

THE WASHBURN & MOEN Co., of Worcester, Mass., had on distribution a very neat little book of electrical memoranda, containing quite a fund of useful electrical data and information.

MR. GILBERT SMITH, of The Ansonia Brass and Copper Co.'s Chicago office, had a pocketful of samples of their well known wires and also presented a beautiful little stamp case to his numerous acquaintances.

THE WESTERN ELECTRIC Co. turned out in force, headed by Mr. E. M. Barton, president, who was aided by his able lieutenants, Mr. Hamilton, Mr. Crandell and Mr. Patterson, in making things pleasant for everybody.

MR. FRANK A. MAGEE, of The E. S. Greeley & Co., of New York, was on deck, and, as always, attending to business and forwarding the interests of his company.

THE STANDARD UNDERGROUND CABLE Co. had their genial Western manager, Mr. Fred Degenhardt, of Chicago, to talk for them. He showed some very handsome samples of bunched cables in twisted pairs, the features of which are remarkably low static capacity and high insulation resistance. This is a new form of cable and will be widely used in telephone work.

MR. GEORGE T. MANSON, of the Okonite Company, of New York, and Mr. W. H. McKinlock, of The Central Electric Company, were around ready to tell the merits of Okonite. They brought no other samples but themselves and did not seem to need any, as they are so well known among the fraternity for good fellows that anything they have must be all right also.

MR. W. A. CHILDS was present in the interests of the Law Telephone Co., and was frequently asked for information relative to the big new Law board they are building for Philadelphia.

GENERAL C. H. BARNEY, as the representative of the enterprising new firm of Alexander, Barney & Chapin exhibited the ingenious Field mercury safety cut-out for telephone and other lines, and distributed explanatory circulars.

OUR SPANISH-AMERICAN NEIGHBORS are beginning to see the advantages which electricity possesses as an illuminant. Some time ago, the Westinghouse company sold a fifteen hundred light alternate current incandescent outfit to be used toward dispelling darkness in the Brazilian town of Juiz de Fora. The Juiz de Fora Company is well pleased with its purchase, and has just asked the Westinghouse people to ship two 750 light machines to supplement the present capacity of its central station.

One of the progressive towns of the vast and rich mineral state of Montana is Anaconda. An electric light company has been formed in Anaconda, and the Westinghouse incandescent system has been chosen. The plant will have an initial capacity of three thousand sixteen candle power incandescent lamps, and 60 arc lights.

CORRESPONDENCE.

PHILADELPHIA.

New Lighting Work.—The Electro-Therapeutic Society.—Infringement of Bell Patents.

THE Electric Light, Heating and Power Company, of Philadelphia, Bucks and Montgomery counties, recently incorporated by Hamilton Disston, Charles A. Porter, Peter E. Costello, Thomas W. South and others, of Tacony, has selected a site on the Delaware river below Tacony, where it will at once begin the erection of an electric plant, with dynamos capable of running 500 arc and 10,000 incandescent lights. The grounds are large, and the buildings will be so constructed that they may at any time be increased as circumstances require.

A number of physicians and surgeons have formed themselves into an organization called the Electro-Therapeutic Society. Dr. George B. Massey is president, and Dr. William H. Walling, secretary. The object of the society is to discuss the question of electricity combined with medicine and surgery. Heretofore the subject has been empirical, and it is proposed to take it out of the hands of the irregulars, so that the regularly certified practitioners can make it popular from a scientific standpoint.

The United States Circuit Court yesterday granted decrees to the Bell Telephone Company restraining Edward, George B., Henry F. and Edward Darby, Jr., John W. Stelwagon, Marcus Sternberg, Andrew J. and Charles S. Bair, Israel Fleishman and Morris and Samuel Lippman from using telephones containing infringements on the Bell patents.

PHILADELPHIA, Sept. 10, 1890.

PITTSBURGH.

New Police System for Allegheny City.—Reducing Fares to Three Cents.—Electric Railway Work. — Material Wanted for Fire Alarm Service.

ALLEGHENY CITY is about to put a new police telegraph and telephone system on the streets, the old one having become so defective that it is practically useless at present.

The Philadelphia owners of the Pittsburgh traction road (Widener-Elkins) arrived in this city a few days ago for a conference, when they decided to reduce the fares on their road from five to three cents. It is understood that this cutting of the fare has been resorted to by the company in order to compete with the Duquesne Traction Company, which is building an electric road almost parallel to the traction road.

At a meeting of the board of directors of the Birmingham Traction Company, held a few days ago, it was decided to extend the road from the South Side into Knoxville and Beltzhoover boroughs, a distance of seven miles. The new road will be equipped with electric motors.

A number of the electric cars of the Pleasant Valley street car line, in this city, have been equipped with a raw-hide pinion wheel, by which means the company intends to lessen the noise which is now made by the motors.

Morris W. Mead, superintendent of the bureau of electricity in this city, has ordered a lot of new material for the fire alarm office. He intends to construct a new key and switch board.

PITTSBURGH, Sept. 5, 1890.

BOSTON.

Edison Work in Boston.—The M. C. M. A. Exhibition.—Postal Telegraph Company's Plant.

THE Edison Illuminating Company, of Boston, are making rapid strides with their increase in Head Place, and have just put in two Babcock & Wilcox boilers, and are now engaged in putting in two tubular boilers fitted up with the Jarvis setting, and furnished by the Jarvis Engineering Company. They have commenced on their new brick smoke-stack, which will be 26 feet by 13 feet by 150 feet high, and are laying the foundation for two 500 h. p. vertical engines, which, when set up, will be belted to four No. 60 Edison dynamos. The Edison Company have now completed their underground construction work, and have covered nearly all the important streets in the city.

The 17th triennial exhibition of the Massachusetts Charitable Mechanics' Association opens at the Mechanics' Building, on the first day of October, and the electrical department promises to be very interesting, as numerous exhibits have already been arranged for. Space can now be secured, and various electrical exhibits are arriving every day. The opportunity afforded for exhibiting in the East the most recent developments in electrical engineering is a good one, and should not be missed.

The Postal Telegraph-Cable Company's central office was removed Sunday from 177 Devonshire street to more commodious and elegant quarters at 234 Devonshire street, opposite Winthrop square. The principal improvements consist of increased accommodations, whereby the force of operators can be enlarged from 40 to 90, an increase in the number of switchboards and loops, whereby the rapid transaction of business is greatly facilitated, and the substitution of dynamos for batteries in the generation of the electric current.

Under the old system of batteries the establishment used 4000 cells, but now by using dynamos the same result is gained by means of coils of resistance, which regulate the current for wires of whatever length.

In the basement are two 10 h. p. Westinghouse motors, each run on alternate days by power from the Edison central stations, and, connected with the dynamos, eight small Westinghouse generators, varying in potential from 20 to 300 volts, according to the length of line and number of instruments to be operated.

The entire work has been done under the supervision of Frank W. Jones, the general manager and electrician of the company. In sending and receiving telegrams a quadruplex system invented by Mr. Jones is used. The office is under the management of Mr. E. B. Pillsbury, who is universally courteous to all visitors in explaining the new system, and showing them every detail of construction.

BOSTON, Sept. 13, 1890.

DUPLEX GAS ENGINES.

BY ELMER A. SPERRY.

It was Prof. Fleeming Jenkin who first gave to the world the mathematical demonstration of the increased economy attending triple and quadruple expansion in the steam engine. Prof. Thurston, in this country, in a recent paper, has pointed out the extremely high theoretical attainment of the latest forms. He says in fact that these have now arrived "to so perfect a condition that the range for further improvement is probably very narrow, and the gain still to be made must come slowly and painfully." The first named eminent authority has further made the statement that "the actual achievement of the steam engine has nearly reached the limit of the possible."

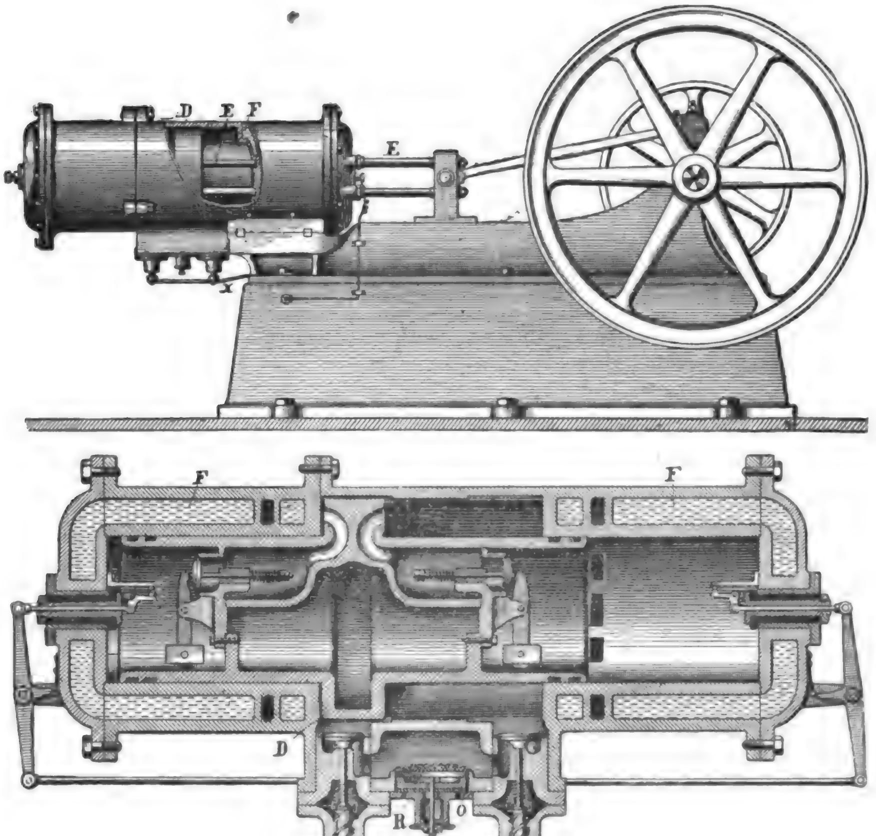
The efficiency of the steam engine when taken as a measure of the recovery of power from the total power equivalent of the heat employed, following the most improved methods, is only about ten per cent. when large units of power are considered. To compare this performance with that of the gas engine, it is but fair that we take equal units in either case. In the comparison of the two motors as heat engines, size for size, the actual performance of the gas engine is over two hundred per cent. better than that of the steam engine, with a vast unexplored region beyond in the case of the gas engine, giving promise of great improvement and higher economy than the most excellent performance yet recorded.

In considering the great problem of transforming heat energy into electrical and mechanical energy it may be well to investigate the laws of operation and working of a system that has already realized so much in the direct line of transformation of heat into mechanical motion.

The gas engine is a hot air engine in which the air as it is drawn into the cylinders is charged with a substance which may at the proper moment yield the heat required to increase its bulk, the confining of which develops the pressures utilized in moving the piston. This increase of bulk on ignition, and the corresponding pressure of the air, is from four to five times. Thus, if the air or mixture in the cylinder at the time of ignition is 40 pounds, the pressure resulting from ignition is about 200 pounds. The ignition does not cause an explosion, as is usually supposed, but, on the contrary, the inflammation goes forward until a certain pressure and temperature is reached, and at this point is arrested, and further inflammation is developed as the piston goes forward and the pressure thereby tends to decrease. The writer has seen cards from gas engines in which constant pressure was developed throughout nearly the entire stroke. This is especially the case with lean mixtures, or below 11½ of air to 1 of ordinary illuminating coal gas.

This system of transferring the furnace, wherein the energy is primarily developed, into the cylinder of the engine itself, and there utilizing directly the benefits of combustion, is undoubtedly the greatest step in advance of the present half century in the direction of high economy and efficiency. There is no doubt that the engine of the future is to have its furnace in its cylinder, thereby eliminating the gigantic waste attending latent heat which is encountered in the case of steam. The high performance of 1.4 pounds of coal per horse power per hour in a ten-horse power engine compares favorably with from 7 to 13 in the steam plant of equal size.

This being true, the question is asked, "Why are not gas engines more sought and employed for ordinary power purposes?" The answer to this question can only be found by a study of the performance of the present gas engine, noticing the difficulties encountered and the limited application to the more exacting power consumers, and the devices resorted to in the attempt to overcome



FIGS. 1 AND 2.—NEW DUPLEX GAS ENGINE.

some of these difficulties. The greatest evil of the present method and cycle of operation in the gas engine is the want of uniformity of speed in the power developed. This is owing to the fact that usually but one out of four, frequently one out of eight, of the strokes or units of power is available for producing effective results. The others are not only non-productive, but actually consume the energy developed in the one. It is true that engines have been produced that make every other stroke an effective stroke; but this system at best produces irregularity that renders it indifferent for driving more delicate machinery, especially electrical generators for lighting purposes. It is true that dynamos may be driven by existing engines to supply storage batteries with some degree of success. But where direct illumination is required, the noticeable irregularity and throbbing prohibits general adoption.

The gas engine of to-day undoubtedly stands in the same position as the steam engine in 1860, when Charles T. Porter first proposed to develop double or triple the power from the same weight of materirl for the same weight of engine, by increasing the number of its power producing elements per minute from 50 strokes, as was the practice, to 250. Or to follow history in steam engineering still further back in the days of Newcombon and Crawley, when all cylinders were sing e-acting and a multiplication of cylinders was required to increase the number of power strokes.

The commercial gas engine of to-day has a single acting cylinder. The difficulties of packing against the high temperatures have been found, and probably will remain, insurmountable. French engineers have sought in vain, through long continued and expensive experiments, to find methods of packing a piston rod against the high temperatures of the cylinder, and thus to produce a double-acting gas engine. The American engineers have heretofore tried, but thus far have failed, to produce a double-acting gas engine.

The most successful practice in gas engines has been followed in producing the engine illustrated herewith, that is, single acting combustion cylinders are used which are placed opposite to each other and form a single mechanical element. Midway between them is a cylinder of larger bore performing the office of a pump for transferring the mixtures to their proper destination before combustion. The compound piston, which reciprocates in these three cylinders, is also a single mechanical element, the two ends of similar size forming plunger pistons operating in the combustion cylinders, in the middle of which is an annular enlargement, which fits the larger bore of the pump cylinder. The differential area so produced between the combustion piston and the pump cylinder is the area which is available for transferring the gases and forms the piston area of the pump cylinder.

It is to this element, namely, the annular-shaped pump piston, that the main piston rods, E, two upon each side, are attached, as may be seen in Fig. 1, thereby eliminating the necessity of packing against the high temperatures; the only packing required in the piston rods is against the low pressures of the cold mixture within the pump. It will be seen in Fig. 2 that the two combustion cylinders are at opposite ends of the compound cylinder. The water jackets are shown at F. Along parallel to the front cylinder are the cored passages, G, in which the two piston rods, E, connecting with the cross head, reciprocate. The packing glands, I, are required to pack only against the small pressure of the gases in the pump cylinder. This pressure is so slight that it may be wholly disregarded.

The law of operation or cycle of the engine is as follows: The pump is double acting and is provided at either end with an induction valve, below which is a screw, by turning which the seating of the induction valve may be varied. This varies the pressure within the pump, and, therefore, the amount of mixture transferred into the combustion cylinder previous to ignition. The ignition is performed by the electric spark, the two igniters being coupled in multiple arc. The mixing device is peculiar, extremely simple, and consists of a valve, O, covering both gas and air passages in a perforated plate. This valve is so large as to nearly fill the circular space in which it is contained, leaving only a very narrow circular slot at its periphery. The gas and air as they are drawn through this narrow slot are given a very high velocity by the suction of the pump at either end. A wire gauze diaphragm, R, stands immediately in front of this passage and completely breaks up the rushing gases as they emerge from the slot. These, as they reunite, form a most intimate and complete mixture.

Experiment has shown that this mixture attains almost theoretical perfection, aiding materially in the perfection of combustion and economy attending the operation of the engine. The compression of the engine is from 35 to 45 pounds before ignition when the engine is working near its capacity, and from this figure down to atmospheric compression when working less than its rated capacity. A governor on the axle is connected by a rod, X, to the two screws beneath the induction valves, and thereby automatic regulation is obtained, which is found in practice to hold the engine within three per cent., from full load to zero.

The actual performance of the engine is very high, being from 19 to 21 cubic feet per horse-power hour. The perfect uniformity of speed is obtained, owing to the fact that every stroke is effective, and a comparatively small weight of engine is required to the horse-power. Chief among its merits also is its low cost of manufacture.

A 13 horse-power engine of this make weighs only about 1900 pounds, and requires but a small fly-wheel, and for purposes of driving dynamos the fly-wheel may be used for a band wheel, about the same practice being followed as in steam engineering in determining the weights of these elements.

The engineering department of the Patent Office looked upon the case with unusual interest owing to the fact of its being the first system of construction which rendered the double acting gas engine feasible, and a patent containing some sixty-five claims was granted upon it.

REPORTS OF COMPANIES.

THOMSON-HOUSTON ELECTRIC CO.

The following item of interest is from the Boston *Herald:*

The Thomson-Houston Company has been selling preferred stock, but not in the market. It has been sold privately, for home and foreign investment, and the proceeds are being used to take up the outstanding notes. A few statistics regarding this company's capital stock will be of interest:

Preferred stock chartered	$ 5,000,000
Common stock chartered	10,000,000
Preferred authorized for issue by shareholders	4,000,000
D'o common	7,500,000
Preferred stock issued, about	8,500,000
Common stock issued	4,500,000

This shows an increase of $2,500,000 in the outstanding preferred stock the present year. Besides the proceeds from stock, the company has yet to receive some $1,000,000 from its debenture notes, and has plans which may soon retire every dollar of floating obligations, except current bills which current income takes care of. A cash dividend upon the common stock in January is quite within the range of probability. The company has orders footing over $4,000,000 on hand in its various departments, and a high authority says it will earn $2,000,000 net in the last half of the year. The same authority says that when the present management acquired the original property it paid $40 per share for stock on which $17 had been paid in, and its earning power was 5 per cent. It then had two sub-companies using its apparatus and paying tribute. To-day the accounts showed about $45 per share actually invested, counting the patents as nothing, and the earning capacity was 20 per cent., and there were 1,000 to 1,200 sub-companies to use its apparatus and pay it tribute. Moreover, its rivals, like the Brush and Fort Wayne companies, were now a part of its assets.

STOCKS AND BONDS.

WESTERN UNION.—The Directors of The Western Union Telegraph Company have decided to pay a dividend of 1¼ per cent. on the capital stock Oct. 15. The income for the quarter ending Sept. 30 is estimated at $2,000,000. The dividend will require $1,077,400, and after paying fixed charges there will be left, it is figured, a surplus of $10,642,383.30. The surplus July 1 was $9,962,983.30.

COMMERCIAL CABLE.—A quarterly dividend of 1¼ per cent. upon the outstanding stock of the Commercial Cable Co. will be paid Oct. 1 for the September quarter.

AMERICAN BELL.—The directors of the American Bell Telephone Co. have declared an extra dividend of 3 per cent, payable October 15.

TROPICAL AMERICAN TELEPHONE CO.—The stockholders of the Tropical American Telephone Company can collect a dividend of 10 per cent. per share Oct. 1, to stock of record Sept. 15. Books will close Sept. 15 to 20. There will probably be dividends also Jan. 1, 1890, and April 1, 1891, as funds are in hand.

THE MODERN MATCH.

Husband (getting ready to light the gas)—"My dear, I wish you would remove all newspapers and other combustible material to the next room. Then send for several pails of water and have them handy." Wife—"Why, what for?" Husband — "I am going to strike a match. Of course it will break, and there is never any telling where the burning end will land."—*Street & Smith's Good News.*

MR. F. O. RUSLING is to represent the Connecticut Motor Co. at the Edison Convention in Minneapolis, and also at the St. Louis Exposition.

FINANCIAL MARKET.

QUOTATIONS ON ELECTRICAL STOCKS.

Mr. F. Z. Maguire, Electrical Securities, of 18 Wall street, this city, reports the following quotations of September 12th from New York, Boston and Washington:—

NEW YORK.

	BID.		BID.
W. U. Tel. Co.	83¾	Edison Gen. Elec. Co.	30
American Tele. & Cable	83	Edison Gen. Co. Def'd	....
Centl. & So. Amer.	157	Conso.'d Elec. Lt. Co	60
Mexican	205	Edison Illu'g Co. N. Y.	...
Com. Cable Co.	....	U. S. Elec. Lt. Co.	35
Postal Tel. Cable	39		

BOSTON.

	BID.		BID.
Thomson-Houston	49¼	Westinghouse	37¼
" Pref'd.	25¼	Ft. Wayne Co.	11½
" Series C.	12	Am. Bell	224
" " D.	5¼	Erie	48¼
" Int. Co.	....	New England	51
Thomson Welding Co.	..	Mexican	.90 cts
Thomson Eu. Welding	81	Trop. American	..
		Edison Phon'gph Doll.	2

WASHINGTON.

	BID.		BID.
Penna. Telephone	25	U. S. Elec. Lt. (Wash)	162¼
Ches & Pot. Telephone	70	Eck. & Sold. Home Elec. Ry.	66
Amer Graphophone	16		

PITTSBURGH.

	BID.
Westinghouse Electric and Manufacturing Co.	38¼

PATENT NOTES.

INTERFERENCE ON ALTERNATING DEVICE OPERATING BY REPULSION—W. STANLEY, JR. vs. ELIHU THOMSON.

The interference in the United States Patent Office pending for nearly two years between an application of William Stanley, Jr., and the previously issued patent to Elihu Thomson, on the well-known alternating current motive device operating by repulsion, was decided by the Examiner of Interferences on the 4th inst. in favor of Prof. Thomson. The subject-matter of the interference covered broadly the principle which has been treated so fully in the lectures of Prof. Thomson, and has recently been taken up by foreign experimenters and made the subject of published lectures by them also.

INVENTORS' RECORD.

Patents issued Sept. 2, 1890.

Alarms and Signals:—*Automatic Electric Annunciator*, J. W. Luthe and A. E. Jeavous, 435,440. *Push-Button*, G. H. Streickenberg, 435,866.

Conductors, Conduits and Insulators:—*Apparatus for Covering Electric Wires*, A. G. Holcombe, 435,629. *Pole for Electric Wires, etc.*, E. Verstraete, 435,872.

Distribution:—*Automatic Regulation of Electric Circuits*, G. B. Prescott, Jr., 435,545. *Device for Controlling the Current of Electric Generators*, H. W. Leonard, 435,700.

Dynamos and Motors:—*Electric Motor*, H. N. Blades, 435,639. *Means of Making Armatures for Dynamo-Electric Machines*, T. A. Edison, 435,690. *Electric Motor*, H. Groswith, 435,744. *Electric Current Regulator*, E. H. Johnson, 435,899.

Galvanic and Thermo-Electric Batteries:—*Battery-Compound*, E. M. G. Hewett, 435,421. *Process of and Apparatus for Generating Electricity*, T. A. Edison, 435,688.

Lamps and Appurtenances:—*Switch for Incandescent-Lamp Sockets*, W. C. Bryant, 435,578. *Manufacture of Filaments for Incandescent Lamps*, V. M. Hobby, 435,660.

Measurement:—*Electrical Measuring Instrument*, G. W. Walker, 435,550.

Metal-Working:—*Method of Electric Welding*, M. W. Dewey, 435,643 and 435,644.

Miscellaneous:—*Electric Switch*, C. W. Huntington, 435,424. *Workman's Time-Recorder*, F. L. Fuller, 435,582. *Electric Cigar-Lighter*, J. Roberts, 435,668. *Electric-Current Indicator*, A. B. Herrick, 435,695. *Electrical Indicator*, J. W. Howell, 435,896. *Electrical Controlling and Operating Apparatus*, E. H. Johnson, 435,897 and 435,898.

Railways and Appliances:—*Electric Conductor for Street Railways*, L. M. Perkins, 435,447. *Electric-Railway Closed-Circuit System*, Malone Wheless, 435,471. *Block-Signal System*, M. S. Couly, 435,482. *Conduit for Electric Railways*, W. R. Elliott, 435,486. *Electric Conduit*, W. R. Elliott, 435,487. *Means for Supporting Storage-Batteries on Railway-Cars*, H. H. Blades, 435,640. *Electric-Railway Car*, H. H. Blades, 435,641 and 435,642. *Railway Signal*, W. F. Z. Desant, 435,558. *Upward Pressure Contact for Electric-Railways*, J. A. Duggan, 435,559. *Electric Railway*, R. M. Hunter, 435,662. *Railway-Signal*, M. Cortese, 435,801. *Suspending Device for Overhead Electric Conductors*, E. Thomson, 435,870. *Electric Railway*, R. M. Hunter, 435,879.

Secondary Batteries:—*Means for Charging and Using Secondary Batteries*, T. A. Edison, 435,687.

Telegraphs:—*Telegraphy*, T. A. Edison, 435,689. *Telegraphy*, A. Muirhead, 435,851. *Electric Signaling Apparatus*, A. A. Hatch, 435,893 and 435,894.

Telephones and Appliances:—*Telephony*, T. D. Lockwood, 435,438. *Method of and Apparatus for Producing Musical Sounds by Electricity*, G. Breed, 435,679.

Patents issued Sept. 9, 1890.

Alarms and Signals:—*Electric Burglar or Automatic Fire Alarm*, Edmund R. Wilder, 436,030. *Electric Signal for Railways*, George A. Tower, 436,025. *Electric Signal for Railroads*, Frank C. Schroen, 436,154. *Electric Danger and Safety Signal for Railroads*, Edward M. Burt, 436,168. *Railway Signal*, James Richardson, 436,191.

Conductors, Conduits and Insulators:—*Insulator*, J. C. Firth, 436,225. *Insulator Bracket*, H. E. Chubbuck, 436,120.

Distribution:—*Electric Converter*, George Westinghouse, Jr., 436,200. *Pulsating-Current-Battery System*, C. J. Van Depoele, 436,275.

Dynamos and Motors:—*Regulator for Dynamo-Electric Machines*, William Stanley, Jr., 435,992. *Magneto Electric Machine*, Lamotte C. Atwood, 436,-113. *Electric Motor*, Thomas A. Edison, 436,127. *Steam Dynamo Electric Machine*, Edward C. Newton, 436,148. *Adjustable-Current Reciprocating-Engine System*, C. J. Van Depoele, 436,276.

Galvanic Battery:—*Electrolyte for Galvanic Batteries*, Frank K. Irving and Frederick M. Hill, 436,001.

Lamps and Appurtenances:—*Lamp Holder and Switch*, Charles H. Herrick, 435,931. *Electric Lamp*, William D. Graves, 435,967. *Electric Incandescent Lamp*, John S. Potter, David J. Cartwright and Benjamin B. Keyes, 436,316.

Metal-Working:—*Electric Power Hammer*, Charles J. Van Depoele, 436,277. *Electric Soldering Iron*, C. E. Carpenter, 436,119.

Miscellaneous:—*Method of Regulating Electrically Operated Mechanism*, Merle J. Wightman, 435,958. *Rheostat*, Frank Thone, 435,965. *Electric Detonator or Primer*, Henry T. Smith, 436,023. *Electric Switch*, Charles G. Perkins, 436,107. *Cut-Out for Electrical Translating Device*, C. G. Perkins, 436,087. *Lightning Arrester*, G. D. Hoop, 436,238. *Double Pole Snap Switch*, H. H. Crowell, 436,122. *Reciprocating Snap Switch*, J. S. Gibbs and C. G. Perkins, 436,080. *Electric Valve Controller*, H. W. Deeds, 436 219. *Watch Demagnetizer*, C. F. Berlin, 436,205.

Railways and Apparatus:—*Electrical Traction Apparatus*, William Stephens, 435,983. *Portelectric*, John T. Williams, 436,281. *Electric Lighting and Heating Apparatus for Electric Railways*, M. W. Dewey, 436,125.

Secondary Batteries:—*Secondary Battery Plate*, Thomas P. Whittier, 436,050.

Telegraphs:—*Electrical Amusement Reporting Apparatus*, Melvin D. Compton, 435,961.

EXPIRING ELECTRICAL PATENTS.

Reported by F. B. Brock, *Patent Attorney*, 639 *F street, Washington, D. C.*

Expiring in September, 1890.

Automatic Telegraph, G. Little, 142,481; *Perforating Telegraph*, 142,485; *Relay and Sounder*, 142,486; *Battery*, A. L. Nolf, 142,502, September 2, 1873. *Regulator*, T. A. Edison, 143,688, September 9, 1873. *Telephonic Telegraph*, W. D. Sargent, 142,817; *Morse Register*, M. F. Wessmann, 142,825; *Transmitter*, M. F. Wessmann, 142,826; *Regulator*, G. F. Lufbery, 142,925, September 16, 1873. *Battery*, T. A. Edison, 142,999, September 23, 1873. *Key*, D. L. Parkhurst, 143,296; *Multiple Telegraph*, M. Gally, 143,340, 143,341; *Fire Telegraph*, J. H. Guest, 143,-344; *Tool or Machine*, D. M. Smyth, 143,388, September 30, 1873.

[Copies of drawings and specifications of any patent will be furnished by Mr. Brock, at 15 cents each.]

FIRE AT THE BROOKLYN INSTITUTE.

A fire, for which no origin has yet been suggested, broke out on Friday evening last about 6 o'clock in the old Brooklyn Institute building, where so much educational, literary and scientific work has been done. Before the fire stopped the building had practically been gutted, and few things of value were saved by Prof. Hooper. Among the sufferers by the fire is Prof. Vander-Weyde, who had in the building a most interesting and valuable, as well as irreplaceable, collection of electro magnets, telephones, batteries and other electrical apparatus.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

INDURATED FIBRE FOR SUBWAYS AND CONDUITS.

REFERENCE was made in the last issue of THE ELECTRICAL ENGINEER to the use of indurated fibre pipe for underground telephone work in Philadelphia, where, according to Dr. S. M. Plush, it has proved very satisfactory and has stood severe tests during a period of over 18 months. This material now bids fair to assume considerable importance in subway work, and deserves the attention of the electrical public. It is made by a patented process from long wood fibres, separated, washed free from all saps and gums, molded while in a pulpy state into the requisite size and shape and then subjected to great hydraulic pressure. After this it is treated and hardened by a special chemical process that renders it impervious to moisture, acids or gas. It is, moreover, extremely tough and durable, and will withstand enormous crushing strains. The tensile strength is about 1,100 pounds to the square inch. Its weight is about one-fifth that of iron for equivalent service in pipe form. It will resist over 200 degrees of heat, is remarkably insensible to the rigors of winter, and is easily handled as well as readily reamed and threaded.

The method adopted for the use of this pipe for electric light subway work is practically as follows:—The manhole chambers have a bottom of asphalt concrete upon which is placed a flooring of indurated fibre in a slab about an inch or more in thickness. The walls of the chamber are similarly treated. The wires are carried through these manholes in rubber tubing, which fits tightly on either side of the chamber over a nipple with screws over the ends of the pipe. A packing of phenicite helps to exclude moisture and seals the whole hermetically. This phenicite is a plastic compound capable of resisting very high temperatures in connection with electrical work. The pipes used are generally 1½ inches inside diameter with ½ inch shell, and are joined together with collars, in which they are fastened by means of screw threads. The junction box, made of the same material, is about 12 inches long, 6 inches wide and 5 inches deep. The ends are tapped for screw threads and the main pipe screws into them on either end. The box has a removable cover which is fastened with iron machine screws, countersunk. The heads of the screws are treated with wax or similar preservatives to prevent oxidization. The inner edge of the box is grooved and a perfectly tight connection is made by means of linen gaskets thoroughly saturated in phenicite.

The service pipes, when it is necessary to make an angle, are fitted with screw threads and are made a little smaller than the cover apertures through which they pass. They are fastened by jam nuts, placed respectively on the inside and outside of the box cover and made tight by gaskets served with phenicite.

To make it unnecessary in new construction or repairs to remove pipe protecting service wires, the service or side pipes at the threaded part are made slightly larger than the main part of the pipe, in order to allow the outside jam nut and the cover to slip back over them, when unscrewed, for the purpose of exposing the main wires.

The operation of connecting from the main wire to a house or to any point at right angles is as follows:—A trench is dug from the street main to the point requiring service and connection is made at the service point. This service wire is then strung through pipe and collars of the same material, until the junction box in the street is reached. The service wire is connected with the main wire passing through junction box. The service pipes and collars are then screwed tight, each joint being carefully cemented with phenicite.

The pipes are laid in a concrete of cement, sand and gravel, the faces of the boxes being left free of the concrete for easy removal.

The junction boxes occur every 50 feet and are placed one above another, either in direct line or staggered. A number of pipes are used as service pipes along the route and can be changed over at manholes, bringing another set of apertures in the next section or block. The phenicite is used to insure perfect joints and to facilitate construction. It is also applied to the surface of the conducting wires as a lubricant to facilitate drawing them through the conduit, thereby preventing injurious abrasion or strain.

Such, in brief, is the method adopted in subway work for lighting wires, with modifications for telegraph and telephone wires, or for combination of all three services.

This system is now being introduced by the Indurated Fibre Pipe Co., of 40 Wall street, this city, with factory at Mechanicville, N. Y. Mr. J. L. Brownell is president; Mr. Jonathan Brownell, treasurer, and Mr. H. J. Medbery, secretary. As mentioned above, it is already in successful use in Philadelphia, where 40 miles are laid. In Detroit, the Detroit Electric Light Co. have about 20,000 feet, and the local Edison company some also. The Pennsylvania Railroad Co. have it laid in five different places, each with conditions of its own, and it is highly reported upon. The Badger Illuminating Co., of Milwaukee, and the Mt. Morris Electric Light Co., of this city, are both using it; and the Fort Wayne Electric Co. have adopted it for all their work. It has also been used for work in the Bonair Hotel, at Augusta, Ga., by the Edison company, and in the new hotel at Fifty-ninth street. Mr. Medbery informs us that he has never had a single unfavorable report on it, but that in every case it is working well. Specimens that have been underground for four years were exhumed and tested recently and showed no change whatever, being as good as when laid.

MOTOR BUSINESS OF THE EDISON GENERAL ELECTRIC CO.

A SHORT time ago the hint was thrown out in THE ELECTRICAL ENGINEER that the "small motor" field open deserved to be worked all the year around. There seems to have been a general impression that the great harvest time for small motors is the hot season when fans are in the briskest kind of demand; and that when the summer draws to a close, the central station superintendent can rest on his laurels in the power department and concentrate his energies upon the lighting business. In fact, nothing could be more of a mistake than this. Even so far as fan motors alone are concerned, the opportunities of sale are certainly excellent during the winter months, when in hot and crowded rooms ventilation is required that cannot be obtained by the opening of windows; and when, in various places, quite as much in January as during July, agitation of the air is required to keep it pure and fresh. There are, moreover, numerous fields of work that have yet been untouched or barely scratched. In the household, for example, the little motor that can do so much to lessen the work and alleviate the worries attaching to domestic duties, is almost a total stranger, even in towns and cities where the electric circuits are well nigh as familiar and common as waterpipes. What are 50,000 small motors among the millions of families of this country? What would even 500,000 be? And, then, there are the countless small industries where a quarter or a half of a horse power available in this handy form proves the most valuable of aids and acquisitions; yet how small is the number of minor establishments where the diminutive "jack of all trades" has been set humming his cheery tune! Nothing could tend more to the diversification of industries and the perfection of handicrafts than the possession of these compact little mechanisms.

Recognizing these facts and many others that belong to the subject, the Edison General Electric Co., through its stationary power department, of which Mr. H. Ward Leonard is the chief, has just issued a special announcement, to be found elsewhere, in our advertising columns, on the work it is ready to do in connection with the development of the small motor business. This special circular of the Company calls attention to the small motors it is handling, and gives a variety of information as to their size, speed, etc. It also gives data in regard to the Edison generators, which are being found not less useful for power work than for lighting. Altogether the company is to be congratulated upon its enterprise in this line and upon what must be regarded as its timely movement in arousing the activities of central station companies for a winter campaign.

A WORD OR TWO ON ACCUMULATORS.

AN interesting batch of circulars reaches us from the Accumulator Company, of 44 Broadway, this city. One of them consists of a number of recent testimonials dealing with a variety of uses to which the cells have been put. Thus Potter Palmer tells of the work done in the big Palmer House in Chicago and at his private residence. Another letter from Mr. G. Clark describes their use in connection with motor fans used on Atlantic steamships for ventilation purposes. One letter comes all the way from Honolulu, telling how, in the far off Sandwich Islands, James Campbell, C. B., has tempered exile by putting a storage plant into his residence at Waikiki. Lieut. Bradley A. Fiske tells how the cells he had on board the U. S. S. "Chicago" were often roughly handled, used as targets by expectorating seamen, and washed off with salt water, but were very satisfactory in all his experiments. Mr. F. Jarvis Patten, the well-known inventor, deserves quoting in full. Under date of July 22, this year, he writes: "I have used your storage batteries constantly since November last at my laboratory here as well as in Philadelphia. I have used the '15M' cell of your most recent and improved form for driving the distributor motors in my multiplex telegraph system also for past month. I have used 60 cells of your smallest size battery, originally designed for medical apparatus only, in lieu of about 125 cells of ordinary gravity battery, for telegraphic transmission over the 100 mile circuit I use daily between New York and Philadelphia. With reference to the first lot, large size, used for motors, I am pleased to inform you that notwithstanding very irregular use, these cells have given me thorough satisfaction during the eight months I have had them in use, being more reliable for a con-

stant E. M. F. than the dynamo circuit I use for charging them. The line battery to small cells occupying six cubic feet of space take the place of more than 100 cells of gravity, and require far less attention than the latter, and, so far as observed, give better results. I consider your improved forms of storage battery far superior to any I have seen in use, and with proper care in handling, as to charging and discharging, they are an exceedingly convenient and reliable source of current." The yachtsman, W. H. Starbuck, has been able, with the help of the cells, he writes, to get excellent illumination for the "Tillie"; and last, but not least, one or two of the phonograph companies make report of the results they have obtained in using stored electricity to obtain stored talk.

With this pamphlet goes a circular dealing specially with the use of accumulators for street car propulsion, and the packet is completed by a dainty folder, bearing the compliments of Mr. D. H. Bates, and addressed to various classes of persons likely to require accumulators. It will be strange indeed if all this literature, evincing as it does a keen appreciation of the value of printer's ink, does not prove effective with the public it is addressed to. It may be added that the envelope has "Stored Electricity" on it in large letters.

THE ELECTRICAL EXHIBITS AT THE MINNEAPOLIS INDUSTRIAL EXHIBITION.

BESIDES the magnificent Egyptian tower of light described on another page, the Minneapolis Exhibition this year contains a number of notable electrical exhibits. Among these is Mr. Edison's personal exhibit on the second floor of the building, extending the entire length of the light well, and from the light well to the wall. Here can be seen working models of all of Mr. Edison's inventions which are attracting a great deal of attention from the thousands of visitors in the building every day. The phonographic dolls, as shown in a spacious theatorium, give intense satisfaction to all who hear them, as they are the very latest type made, having a natural voice and a vocabulary of over one hundred words apiece. The phonographs proper are finely exhibited in the art department, under the intelligent care of Mr. A. T. E. Wangeman, of Mr. Edison's laboratory. This is a very popular resort, and those hearing the fine records exhibited are delighted with them.

Besides these personal exhibits of Mr. Edison, the Edison General Electric Co., under its representative, Mr. W. S. Howell, has a fine exhibit of its products, consisting of dynamos, motors, bare and insulated wires and cables, underground conductors and electric light fittings, which make an attractive display.

One of the exhibits which is attracting a great deal of attention is that of the Thomson Electric Welding Co., which has a full display of its apparatus for various classes of work in operation, welding everything, from a pin to a pipe four inches in diameter. Mr. Gorton, the electrician from the Lynn factory, has charge of the exhibit.

The Interior Conduit and Insulating Co. have a very neat exhibit of their tubes and conduits, which is very interesting to Minneapolis people at the present moment from the fact that many miles of their conduits are being used on the immense system of electric railroads, now being placed in operation in Minneapolis.

Another most interesting exhibit is that of the Carpenter-Nevins Electro-Heating Co. Beginning by experimenting in a small way a few years ago, the gentlemen comprising this firm have utilized the heating properties of electricity for sad irons, griddle cake pans, coffee and tea-pots, clothes boilers, vats, and many other appliances for household and laundry use where heat is necessary.

WESTERN THOMSON-HOUSTON SALES.

The following is a list of the sales made by the Chicago office of the Thomson-Houston Co. during August:—National Forge & Iron Co., E. Chicago, Ind., 20 arc; A. H. Andrews & Co., Chicago, Ill., 600 direct incandescent, 110 v.; McDonnell & Church, Lowell, Mich., 30 arc; McDonnell & Church, Lowell, Mich., 300 alternating; Consolidated Piedmont Cable Co., Oakland, Cal., 30 arc; H. A. Foster & Co., Pontiac, Ill., 100 direct incandescent, 110 v.; H. M. Loud & Sons Lumber Co., Au Sable, Mich., 50 arc; Mt. Pleasant Electric Co., Mt. Pleasant, Mich., 30 arc; St. Louis Republic Co., St. Louis, Mo., 300 direct incandescent, 110 v.; Peninsular Electric Light and Power Co., Houghton, Mich., 50 arc; Albion Electric Light Co., Albion, Mich., 650 alternating; Citizens St. Railway Co., Indianapolis, 30 arc; H. H. Brown, Canon City, Col., 650 alternating; Dernberg, Glick & Horner, Chicago, Ill., 45 arc and 100 direct incandescent, 110 v.; Cicero Gas, Water and Electric Light Co., Oak Park, Ill., 1300 alternating; Yazoo Water Works and Electric Light Co., Yazoo, Miss., 650 alternating; Yazoo Water Works and Electric Light Co., Yazoo, Miss., 50 arc; Watertown Electric Co., Watertown, Wis., 50 arc; Western Electric Construction Co., Denver, Col., 400 arc and 5200 alternating; Maryville Electric Light and Power Co., Maryville, Mo., 30 arc and 650 alternating; Marysville Electric Light Co., Marysville, Kan., 650 alternating; Brookfield Electric Light Co., Brookfield, Mo., 650 alternating; Springfield Electric Light and Power Co., Springfield, Ill., 1300 alternating; Oakland Gas, Light and Heat Co., Oakland, Cal., 50 arc; Edison Electric Light and Power Co., Little Rock, Ark., 10 h. p., 110 v.; Capital Electric Co., Nashville, Tenn., 10 h. p., 500 v.; Elastic Metallic Packing Co., Omaha, Neb., 1½ h. p., 500 v.; H. D. Preston, Kansas City, Mo., 10 h. p., 220 v.; Kalamazoo Electric Co., Kalamazoo, Mich., 50 arc; Famous Manufacturing Co., E. Chicago, Ind., 300 alternating.

WESTERN ELECTRIC DOUBLE CARBON LAMPS.

The Western Electric Co. are going right ahead with the manufacture of their well-known double carbon arc lamps, and will shortly place upon the market a new form of lamp which is superior to anything heretofore got up by them in that line. They announce it as follows in a circular which is signed by Mr. C. A. Brown:—"We solicit your orders for double arc lamps. Our double lamp has no finely geared clock work; no close fitting sliding solenoid cores; no steel pinions or pivots to rust and stick; no gearing to clog with dust. It is practically and theoretically the simplest and best constructed double arc lamp, and the only double arc lamp manufactured for both high and low tension currents. We offer to furnish companies using low or high tension systems with new double arc lamps guaranteed to work satisfactorily, and with guarantee against loss on account of suits for alleged infringement of patents."

WESTINGHOUSE ELECTRIC RAILWAY WORK.

The Westinghouse Electric and Manufacturing Company Railway Department, under the management of Mr. J. L. Barclay, so well known in street railway circles, have now got comfortably settled in their magnificent suite of offices in the Pullman Building, Chicago. The offices are situated on the west side of the building on the ground floor. As you enter is a handsome reception hall, to the left of which is located Mr. Barclay's private office, and behind this a handsomely furnished reception room. Back of this again is a large room where a double truck on running gear and other adjuncts of the Westinghouse system of electric street railway propulsion will be placed on exhibition. On the right of the entrance hall behind a handsome oak railing are the desks of Messrs. Stewart, Osgood and Atkinson, the well-known traveling representatives of the company. In the reception hall, Mr. Reid, who has general charge of the office work, is located, and behind him are the general offices of the company. The whole suite is handsomely furnished and beautifully equipped and lighted with incandescent lamps on tasteful fixtures. The whole planning of the offices reflects the greatest credit on Mr. Barclay, under whose management it has been carried out.

THE EVANS FRICTION CONE.

The Evans Friction Cone Co., of 85 Water street, Boston, inform us that they have just taken the contract for fitting up the entire plant of the Derby Gas Co., Birmingham, Conn., with their system of driving dynamos, which has already become a familiar and valued feature in so many stations. The plant is to be driven in this manner, partly by water power and partly by steam, and the station will be a model one in every respect.

FIBRONE AS AN INSULATING MATERIAL.

The attention of the electrical public was recently called in these columns to the merits and uses of "Fibrone" as an insulating material. It is a solid and plastic substance, presenting many of the most desirable characteristics of hard rubber. It is a perfect non-conductor, absolutely water proof, and proof against the weaker acids. It can be made to withstand concentrated acid solutions and all actions of alkalies, and is therefore particularly useful for battery jars and covers.

Experiments have been made with this substance by several authorities, and more recently Fibrone was submitted as an insulating material to a most severe test in the Merchants' and Manufacturers' National Laboratory of New York.

The result of these experiments plainly showed that Fibrone does not flake off, blister, crumble, crack, expand or contract under ordinary temperatures, and for special purposes is made also to withstand a high degree of heat. Mr. Louis Steinburger, President of the Fibrone Manufacturing Co., of New York, and inventor of this new and valuable material, asserts that it can be made if required absolutely fire proof. It can be sawed, planed, drilled, tapped or turned in a lathe, the same as hard rubber, and be made heavy or light. It can be given in any of the handsomest, delicate and bright colors, and is a very artistic imitation of any natural wood, rare marble, stone, bronze or metal.

On account of its exceedingly low cost, Fibrone has already entered into competition with hard rubber in almost all kinds of

electrical fittings and will be found most economical and valuable either in sheets or in the shape of battery cells and covers, switch boards, tubes, rods, bell boxes, rosettes, etc.

The admirable plasticity of Fibrone is demonstrated by the finest specimens of artistic decoration *en relief* made with this material. We have recently seen a variety of handsome electrical details made from it, including a line of onyx push buttons.

THE NOVELTY ELECTRIC SUPPLY MANUFACTURING CO.

The above company, of 264 West Fourth street, Cincinnati, are very busy at present, having several orders on hand. One from the Northwest Thomson-Houston Co. for iron poles amounts to $12,000. They have equipped what they claim is the most complete electrical repair shop in the United States, and are making a specialty of rewinding armatures and fields for electric railway and electric light plants. They have just closed a very important deal with the C. & C. Electric Motor Co. for handling their motors in Southern Ohio, Kentucky and Tennessee, where they have the exclusive agency. They also carry in stock a full line of combination fixtures, wood and iron poles, etc., and 50,000 Perkins incandescent lamps; everything, in fact, pertaining to electric light, electric railway, telegraph, telephone and house work. Their business is already much larger than they anticipated.

THOMPSON, REED & CO.

Westchester County, N. Y., is fortunate in having its electrical railways in the hands of such experts as Thompson, Reed & Co., of 32 Liberty street, New York city. The system of territorial supervision and inspectorship applied to such a business is an index of the great importance it has assumed in public opinion and esteem.

MORE ELK-HEAD ELECTROLIERS.

A few weeks ago in describing and illustrating the large Chicago house of the Great Western Electric Supply Co., our cut showed one of the novel elk-head electroliers made by this firm. This has attracted much attention at their store, and is now one of the electrical features at the Chicago Exposition. The firm has recently received nineteen mounted deerheads from the Yellowstone National Park, which will also be made into electroliers. We understand that most of these are already sold, and will be sent out as soon as they are wired up.

THE EXHIBIT OF JAS. W. QUEEN & CO. AT ST. LOUIS.

One of the most striking exhibits, as indicating the great advance of home manufactures, is that displayed by Queen & Co., of Philadelphia. This enterprising firm show a full line of their standard electrical test instruments, and for the benefit of those who may not have the opportunity of viewing the exhibit, we will say a few words regarding what may be seen.

First should be mentioned the collection of resistance boxes, which is probably the finest assortment of American make ever placed on exhibit. The "Queen" standard resistance boxes No. 16, standard megohm box (P. O. box), No. 2, and a full line of their new portable testing sets make a showing that will interest every electrician. These testing sets appear to possess valuable peculiarities, used only by Queen & Co., and we hear it whispered that there is a great demand for them.

Ammeters and voltmeters for all classes of work are attractively shown. Well known types are to be seen, such as the Ayrton and Perry, Deprez-Carpentier, Cardew, electrodynamometers, and also Queen's new magnetic vane meters, which, while but recently placed on the market, are finding many friends. They are adapted for central stations, electric railways, marine plants, isolated plants, etc., and the low prices at which they can be obtained place them within the reach of all.

Reading telescopes, galvonometers, speed indicators, testing batteries, and other instruments, together with those mentioned above, go to make up an exhibit that reflects great credit upon Queen & Co.

Mr. Foree Bain has been in the city the past week with regard to the electric railway work in Minneapolis, upon which he is engaged as consulting expert by the local company.

Mr. E. G. Bernard, special agent, reports recent Sawyer-Man plants sold by him as follows:—Victor Mills, Cohoes, N. Y., 300 lights; Wymanskill Mills, Troy, N. Y., 150 lights; Austin Stairs & Co., Amsterdam, 150 lights; Brandywine Mills, Norfolk, Va., 150; Chesapeake Mills, Norfolk, Va., 100; H. M. Quackenbush Rifle Factory, Herkimer, 150, and residence, 60; W. McClyman, Schenectady, 60; Rose Hill Farm, Geneva, 75. The mill in Norfolk made his forty-ninth knitting mill.

"A. B. C."

Already the windows of the big new store of Alexander, Barney & Chapin, at 20 Cortlandt street, arrest the attention of the passerby, and this a good augury of the notice they will receive when filled up with a tasteful display of electrical novelties. At the present moment one of the windows is covered with a huge sign announcing that the firm will begin business there about October 1; and at the top is a diamond enclosing the letters A. B. C. This diamond is the trade mark of the new house, and its selection is excellent. It will soon be as well known throughout the country as any that has ever been used in the electrical business.

The firm inform us that they have already conducted some important negotiations to a successful issue, and there is no doubt that when they start they will carry one of the finest lines of electrical supplies and novelties in the country.

THE SAWYER-MAN CO.

It is understood that, consequent upon the resignation of Mr. P. H. Alexander, the management of the Sawyer-Man Co. has been entrusted to Mr. G. W. Hebard, who has already entered upon his additional duties at the big lamp factory in West Twenty-third street.

WESTERN TRADE NOTES.

Mr. A. S. Manning, assistant engineer of the Chicago office of the Thomson-Houston Co., has just been presented with a handsomely engraved gold headed cane by the traveling experts of the company.

Mr. Harry Small, of the Thomson-Houston Company, has returned from a trip East, where he visited Boston and the company's factory at Lynn, Cape May and other points of interest.

Mr. Ernest L. Clark, secretary of the Illinois Material Company, has just closed one of the largest pole "deals" ever consummated at Moline, where he will immediately ship 35 carloads.

NEW ENGLAND TRADE NOTES.

J. A. Grant & Co., the well-known Eastern agents for the McIntosh & Seymour engines, have removed from their old quarters, at 243 Franklin street, Boston, to 8 Oliver street, where they have much more commodious offices to carry on their largely increasing business. Mr. Grant reports that the factory at Auburn is extremely busy, and that they are taxed to the utmost to keep up with their orders.

The Eastern Electrical Supply and Construction Co. has been formed with capital of $50,000, with headquarters at 65 Oliver street, Boston. They will be sole Eastern agents for the well-known goods of J. H. Bunnell & Co., of New York, and will handle exclusively for the United States the zincs made by the Carr Metal Co., of Fall River, Mass. They will also control the Auxiliary Fire Alarm for Massachussets, besides other specialties which they are not ready yet to name. The company is strongly backed by gentlemen well known in electrical circles, and Mr. G. H. Buckminster, for four years with the Electric Gas Lighting Co., will attend to the wants of customers as head clerk. When the company is fairly started, it is their intention to go into the electric light and power construction business, as well as furnishing all kinds of telegraph, telephone and electric light and railway supplies.

The Jarvis Engineering Co. are enjoying quite a run of business at present in Armington & Sims engines and various boilers, furnished with the famous Jarvis setting. Among their recent sales may be mentioned 100 horse-power engines for the Lawrence Gas Company, Lawrence, Mass.; two tubular boilers, 15 h. p. each, for the Edison Illuminating Company, of Boston; two 250 h. p. Heine boilers for the Chicago Edison Company; a 100 h. p. supplied to the Ball Engine Company for use in an electrical plant in Manchester, Va.; a 1,000 National h. p. heater for the factory of the Thomson-Houston Electric Company, of Lynn. (This is the largest heater the Jarvis Company have ever installed, and weighs over two tons.) They have also shipped a 50 h. p. engine for the Middlesex Machine Company, of Lowell, Mass., for an isolated electric light plant in a new building in Andover, Mass. The Jarvis Company are preparing to install a 60 h. p. Armington & Sims engine in the Mechanics' Hall, Boston, for the exhibition which opens in October, and which will drive a Thomson-Houston dynamo by means of the Evans friction system.

The Rowell American Switch Co., of Boston, have installed one of their patent switches for operating from electric cars, at the corner of Causeway and Canal streets, Boston, which is giving great satisfaction. Two ordinary street cars have been fitted with the necessary apparatus to operate the switch, and it is receiving a thorough and severe test. The switch is attracting a great deal of attention from electric railroads, and the company is having numerous inquiries from roads all over the country. The cost is quite small, and the switch is certainly much required, and will doubtless ere long be extensively adopted.

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Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.

Western Manager, W. F. COLLINS, Temple Court, 225 Dearborn Street, Chicago, Ill

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EDITORIAL ANNOUNCEMENTS

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers*

VOL. X. NEW YORK, SEPTEMBER 24, 1890. No. 125

The honor of a scientific discovery belongs, not to him who first sees a thing, but to him who first sees it with expert eyes, not to him even, who drops an original suggestion, but to him who first makes that suggestion fruitful of results.—George M. Beard.

CONDUIT ELECTRIC RAILWAYS.

AT the convention of the New York State Street Railway Association, held in Rochester, last week, electricity as a motive power was the leading topic. It may be said to have been the only topic, and all electrical engineers must feel gratified at the manner in which the merits and benefits of electricity were eulogized by the street railway men themselves of their own volition. Both the speech of the president and the paper of Mr. McNamara were warm in recommending electricity to those interested in street railways all over the country; and both characterized the overhead trolley system as the best method possible and obtainable at present.

A few weeks ago we discussed the figures of Prof. Adams, compiled for the Census Bureau, showing that in 56 leading American cities electricity is only used on 8.26 per cent. of the street railroads, while, as we pointed out, taking the country as a whole, the percentage rises at once to not less than 25 per cent. of roads and mileage. This difference can only be accounted for on the ground that it is impossible to overcome the strong antipathy entertained in many cities towards poles and overhead wires. Even where these street fixtures are tolerated, there is objection to an extension of the system for new classes of service. In fact, the public, worked up by the sensational stories of reporters in search of the ghastly and picturesque, has come to look upon every street corner with a pole on it as a possible Calvary; and here in New York, this very week, we have the mayor of the city seeking to palliate a gross piece of carelessness on the part of a lineman who, unfortunately, gave up his life on the pole he had climbed. If this be the condition of affairs, as it is, and if it still be, as it is, the determination of electrical inventors and engineers to operate nearly every one of the street railroads by electricity, resort must be had for the bulk of city work to other methods than those of the overhead wire and trolley.

Hence it is that storage battery traction is now receiving so much attention, the failures of the past acting simply as a stimulus and an incentive. There is more activity in that field to-day than ever before. But in the meantime, the conduit system of direct supply, which had fallen into desuetude, especially since the attempts in Boston, has again been resorted to, and it is believed by many that electric traction in the larger cities is to fullfil its mission through the agency of the conduit. We publish in this issue a very complete description of a new system that deserves attention not only on its own account but because of the special circumstances attending the development of street railways in Washington, where it has been put in successful operation experimentally. In legislating on this subject for the District of Columbia, Congress has decided that there shall be no resort to the overhead system. If electricity is to be employed it must be in some other way than that; and the legislation has been made absolutely prohibitive. At this juncture, the conduit system described in our pages has been brought forward, and as it is one in which only the sections under the traveling cars deliver current, the others being dead, it can readily be understood that Washington is very much interested in the matter. The question is one, however, which, as we have shown, concerns some forty or fifty other cities, to say nothing of numerous towns ranging upward to 50,000 inhabitants; and we do not think we are mistaken in saying that the conduit system, after having thus been relegated to obscurity as a direct method of supplying current to the car, will very shortly come to the front again in a commanding manner.

THE USE OF STREETS BY PRIVATE CORPORATIONS.

A SPECIAL committee of the city government of Boston was appointed recently to report upon plans for securing some return to the city for the use of the streets by private corporations operating under franchises and ordinances. The subject is an interesting one, and the conclusions and data of the committee deserve not to be overlooked. The committee report that they found that the local telephone companies of Amsterdam pay to the city, annually, 21½ per cent. of gross receipts; in St. Louis, 5 per cent. of gross receipts; and in Philadelphia, $1 annually for each old pole, and $5 for each new pole, used for the support of wires. Street railway companies also pay large amounts for their locations. In Amsterdam they pay 5 per cent. of their gross receipts, annually; in Baltimore, 9 per cent. of gross receipts, with an additional tax on each car; in Newark, 2½ per cent. of capital stock; in Providence, a certain fixed sum; in St. Louis, a percentage of gross receipts on a sliding scale; while in New York State all street railway franchises are now sold at auction for the highest offer above a certain fixed percentage of gross receipts. The method most generally adopted

is to require the payment to the city of a percentage of the gross receipts.

The committee come to the conclusion that no scheme of taxation is desirable that induces the corporation taxed to lessen the amount of convenience it furnishes to the public. Thus, for instance, a tax of so much per car would tend to reduce the number of cars put into commission, and the public would suffer from crowding. On the whole, the committee dislike such a method as the above, which obtains in Baltimore, for example, and incline to that favored in Philadelphia, where the tax is, for instance, on each pole. Thus, they would require a corporation to pay a fixed sum for each mile of track, or for each pole put up, or for each mile of subway occupied. Here, again, however, there is danger. In New York, the local companies find the rate of $1,000 per mile of subway duct rental excessive, and a tax on top of that would certainly prove a most serious burden on their business. It is stated that so far Boston has enjoyed less revenue than any other city from the privileges it has granted. Granting that the privileges have a fair market value, it is hard to see that Boston has suffered particularly from its generosity to the corporations that supply its people with light, means of locomotion, and other things.

IMPROVEMENTS IN TELEPHONY.

The improvements which are steadily going on in telephone work are evidence of the fact that this branch of applied electricity is in the hands of men who realize that telephony involves engineering in all its branches to a degree unfortunately lost sight of in its early days. With the high standard of construction which is now being observed both in the office and outside of it, marked improvements must follow, and with them come others which add enormously to the value of the line as a working medium. One of the most valuable of these, recently brought out, is that of the simple device due to Mr. J. J. Carty, by which the talking capacity of a given line to which a number of instruments are connected is enormously increased. Our readers may recall that in the early days of telephony, when individual call devices occupied the attention of numerous inventors, the limit to the number of stations which could be placed on a single line was soon reached on account of the retardation caused by the bell magnets, which were placed in series. In Mr. Carty's arrangement the high resistance bells are all placed in shunt across the line, and the defects heretofore experienced are entirely absent. The results already obtained in practice leave no question as to the general adoption of this system. Its value, however, exists further than in the mere improvement in transmission obtained by it, which comes out most strongly in the application for long distance service. By the use of this arrangement it is evident that there is considerable saving in the length of conductor necessary to connect stations, especially those lying at a distance from the main line. Thus, instead of running a double loop to such stations, a simple metallic circuit may now be used in the same way as branches are run from incandescent circuits. The device is one of those simple improvements which are far reaching in their effect.

Electricity at the World's Fair.

The various appointments in connection with the Columbian Exposition at Chicago are now being made. One of the first is that of Mr. Gardiner C. Sims as chairman of the Committee on Electricity and Electrical Appliances. This is an excellent choice by the Commission in many respects. Mr. Sims is a man of great ability, independent wealth, unchallengeable probity, and wide practical acquaintance with the arts. He is an enthusiast on the subject of electricity, and has done much to promote its interests. He may be depended upon to make an excellent chairman of the committee. He is also a member of the Commission committees on manufactures and tariffs and transportation, upon each of which he has been placed because of his intimate knowledge of these important subjects.

Suicide or Otherwise.

A lineman was killed in this city a few nights ago. He went up a wet pole, with bare hands, to see to a lamp that had been affected by the storm, and proceeded to work upon the live circuit. In reporting upon the case Dr. Wheeler, as expert of the Board of Electrical Control, held that the man was responsible for his own death because he failed to wear the rubber gloves provided. In other words, he neglected the most simple and reasonable precautions, and paid the penalty. Mayor Grant, however, is not satisfied, but wants to have it made out that the man was a martyr to duty. It seems to us a very great and deplorable pity that a public official so highly placed as the mayor should thus endeavor to condone and extenuate carelessness of this kind.

The Edison Meter.

The paper read at Minneapolis, by Mr. Kennelly, before the Edison Association, confirms the faith of the Edison Company in the electrolytic meter of Mr. Edison, and gives some interesting information with regard to the latest type of that meter. It is also interesting to note that Mr. Edison has taken up the mechanical registering meter in order to fill a demand which no doubt exists in many quarters for it as a form which consumers frequently insist upon.

Open Circuit Transformers.

In a recent issue we described the latest type of Mr. Swinburne's open circuit transformers and gave the arguments which have determined Mr. Swinburne in the adoption of this type. Principal among these, as will be remembered, is the point claimed by Mr. Swinburne that, although somewhat less efficient on full load than the closed circuit transformers, the open circuit type has a considerably greater all-day efficiency. In this issue Mr. Tesla takes up the question and discusses Mr. Swinburne's arguments, with which he does not agree, and cites his reasons therefor. Mr. Tesla's remarks, taken in connection with his letter, also in this issue, referring to a criticism of his recent work in alternating motors, make an excellent résumé of the discussions which have been going on lately with regard to this subject.

THE WHELESS UNDERGROUND ELECTRIC RAILWAY SYSTEM.

WHILE the progress which overhead electric railways have made in this country commands the admiration of the world, and has just been commented on by Sir Frederick Abel, in his presidential address before the British Association, those who have studied the situation closely cannot fail to have discerned the increasing objection which is entertained to the employment of overhead wires in cities. This feeling,

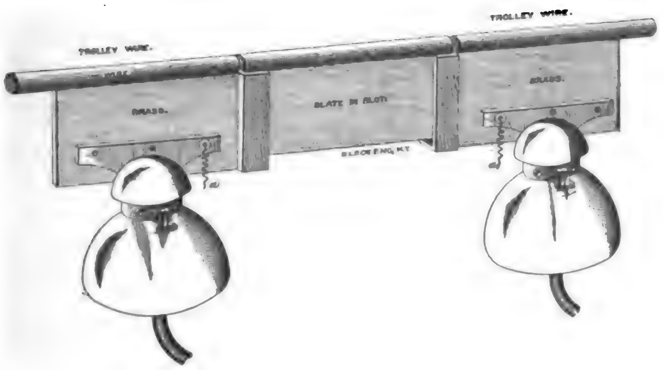


FIG. 2.—ENDS OF ADJOINING SECTIONS IN CONDUIT.

heretofore confined to electric light, telegraph and telephone wires, has now spread to electric railway conductors, and in some of our largest cities electric railways have thus far been practically barred out, while in others now operating overhead systems the extension of such work has been stopped by municipal ordinances. As an example, we need only take the city of Washington, D. C., where, by recent enactment, the running of overhead electric railway wires is now prohibited, though the Eckington and Soldiers'

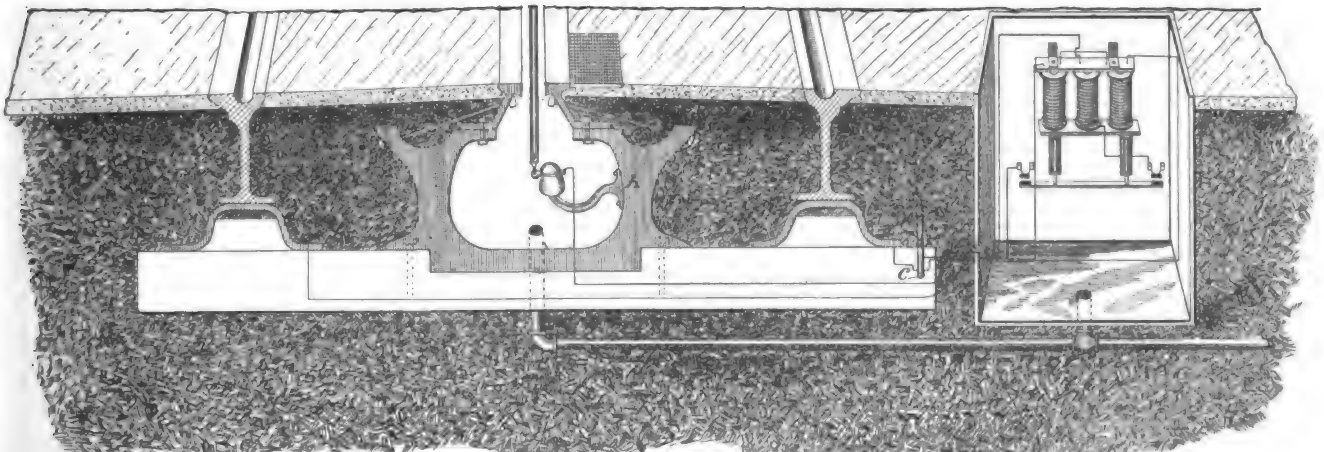


FIG. 3.—SECTIONAL VIEW OF CONDUIT, WHELESS SYSTEM.

Home Electric Railroad, in operation there, is one of the most substantially built and successful roads in the country.

A practical, feasible system of railway conductors, placed entirely underground, will, therefore, in point of fact, open up an immense field, as yet untouched, and add a new stimulus to electric railway operations.

The conditions which confront the constructor of an electric railway conduit system are by no means easy. They involve factors including not only electrical but mechanical details of the utmost importance. We, therefore, desire to draw the attention of our readers to a system of this nature, which has been in successful operation at Washington since last November, and which is the invention of Mr. Malone Wheless, of the Wheless Electric Railway Co., of Washington, D. C.

The road, which has been constructed to demonstrate the practicability of the system, starts near the power-house of the Eckington and Soldiers' Home Electric Railway, and runs for a distance of about one-sixth of a mile, including several abrupt curves and a grade of 11 per cent., thus presenting in a bunch all the severe conditions met with in actual practice.

Mr. Wheless has set himself the problem of furnishing a system which shall at once be safe and afford the least opportunity for leakage—one of the main difficulties to be

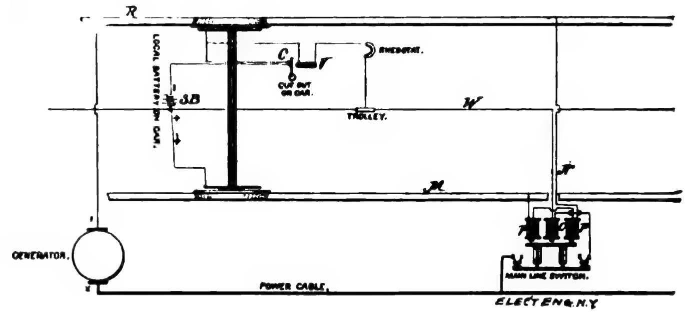


FIG. 4.—DIAGRAM OF CIRCUITS, WHELESS SYSTEM.

overcome in underground work. For that purpose the main current is carried in an insulated cable buried between the tracks, if a double track road, or by the side of the track, if a single track road. This cable extends the entire length of the road, and is the ordinary cable used in electric light work. From this cable the current is automatically switched into the conductor in the conduit. This latter conductor, however, is not continuous, but is built in convenient sections, of, say, 300 feet; and at the end of each section a small switch box is placed in the ground, through the medium of which current from the main insulated feeder is automatically sent into the section of conductor in the conduit over which the car happens to be passing at the time. It follows, therefore, that only a small fraction of the exposed conductor is in circuit at any one time, all other sections being dead. This, therefore, ensures safety and reduces any leakage to that minimum due to the section over which the car momentarily passes.

With this somewhat general description, as preliminary, we propose now to enter into a description of the details by which these desirable results are accomplished and which we were recently afforded an opportunity to examine. The car

itself, as it stands on the track, is shown in the accompanying engraving, Fig. 1, and evidently does not differ in outward appearance from those now in general operation. The conduit in this instance is laid in the centre of the track, and within it a bare wire is supported on insulated fastenings. As before stated, this wire is run in three hundred foot lengths, each length constituting a section. The lengths of the sections can, of course, be

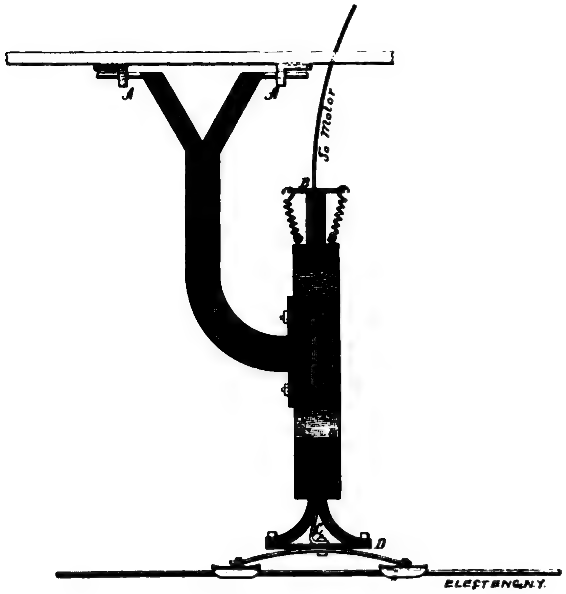


FIG. 5.—TROLLEY AND CARRIER.

made longer or shorter as the necessities of any peculiar construction may demand.

The engraving, Fig. 2, shows the ends of the sections as they appear in the conduit. The two ends of the section, marked "trolley wire," approach each other to within five inches, and are then separated by a block of slate, which is fitted in a slot and makes a continuous coupling between the ends of the wire. The object of inserting the slate is to afford a bearing for the slider and to prevent its jamming on the ends of the sections in passing over them. The ends of these sections are supported by metallic straps which fasten around the insulated hood, the hoods being made strong enough to carry any pressure required from the weight of the trolley and the line. The broken ends of the bracket upon which the hood is screwed are fastened to the side of the conduit, as shown at A in Fig. 3.

The lines shown in Fig. 4, which extend from the sections are passed under the rail and into the switch-box. It is into this line that the current is passed when the armature in the switch-box, which will be described presently, is drawn up; the armature connects the conductor from the trolley wire to a conductor from the feeder cable, C, which is also passed under the switch-box.

A clear comprehension of the operation of the switch-magnets will be obtained from the diagram, Fig. 4. From this it will be seen that when the car enters the section a local battery on the car, consisting of four accumulators, S B, vitalizes the two extreme poles, P P, of the magnet in the switch-box by traversing the rail, M, and returning by the conductor, N, to the opposite rail, thence through the cut-out, C, to the negative pole of the battery. When this is done the armature is instantly drawn up and the current from the feeder cable is let in through the carbon contact points and passes around the centre coil, O, in the switch-box to the trolley wire, W. From this wire it passes to the trolley, then through the rheostat, thence around the magnet V, instantly drawing back the plug at the cut-out, C, and opening the local circuit and battery before entering the ground through the rail, R.

The cutting out of the local battery on the car is evidently a most important feature, as it prevents a draining of the storage cells, and in actual operation these cells are only called upon for current for a fraction of a second as the car passes from one section to the next. This saving on the cells makes it necessary to charge them only once in several weeks, and, as there are only four cells used, they can be put in at any convenient time.

The car repeats the operation just described at every section; thus there is no dead point on the line, as the shoes of the trolley, shown in Fig. 5, are set at such a distance apart that they span the ends of the sections, and the current can be taken to the car through either shoe should the car happen to stop directly over a section.

When the car stops, the current is instantly cut off from the wire in the conduit, owing to the fact that the armature in the switch-box is held up by the main line current passaround the centre magnet, as already described, and as shown in Fig. 4; and in addition, when the rheostat is thrown off, the main line current is cut on the car and the armature, C, instantly falls. The local magnet in the switch-box could not, of course, hold up the armature after the main line current has opened the local circuit on the car.

The engraving, Fig. 6, has been made directly from a photograph of one of the switches now in use on the road. The carbons shown on the ends of the armature have apparently an indefinite life and would only need replacing on account of actual breakage. This feature, as applied to electric railway work, is decidedly novel, and certainly makes closing and releasing of the sections certain, provided there is no bad work mechanically. The current from the cable enters this switch from the line on the lower left hand side of the switch, and its route through the switch can be easily understood by reference to Fig. 4. This form of switch has been in daily operation for over four months and the carbon contact points are apparently in as perfect a state of preservation as they were when first put in.

The trolley used on the car is shown in Fig. 5. It is supported from a beam on the bottom of the car and is given a lateral play by means of the sockets, A, and a perpendicular play by the traveling guide, B. The lateral play is given it to permit of passage around curves, and the perpendicular play allows the guide to hold the shoes on the wire by being forced down constantly by springs on the

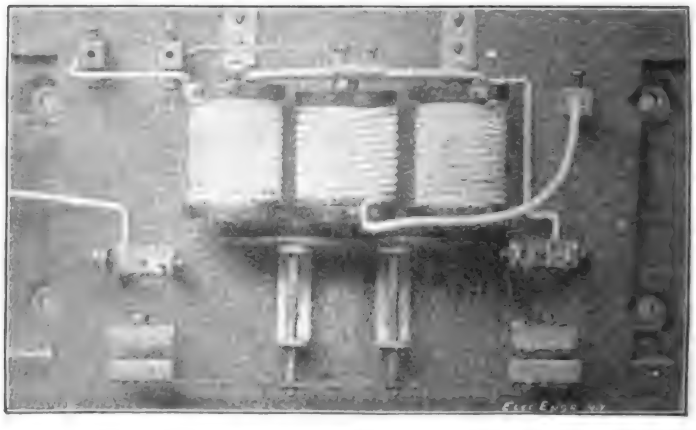


FIG. 6.—SWITCH FOR CONNECTING FEEDER WITH WORKING CONDUCTOR.

top of the guide. The current enters the motor through the two steel friction shoes and passes along the metallic bar connecting them together. From the bar the current passes to the line C, thence through the centre of the traveling guide, coming out at the top and thence to the motor. The frame of the trolley is made of steel and is insulated from the shoes by a heavy piece of insulation, D. The trolley shaft is about half an inch thick, which allows it to fit comfortably in the slot in the conduit. In this way it is difficult for the shoes to leave the wire, and a continuous contact from the shoe to the wire in the conduit is given.

The local cut-out on the car is shown in perspective in

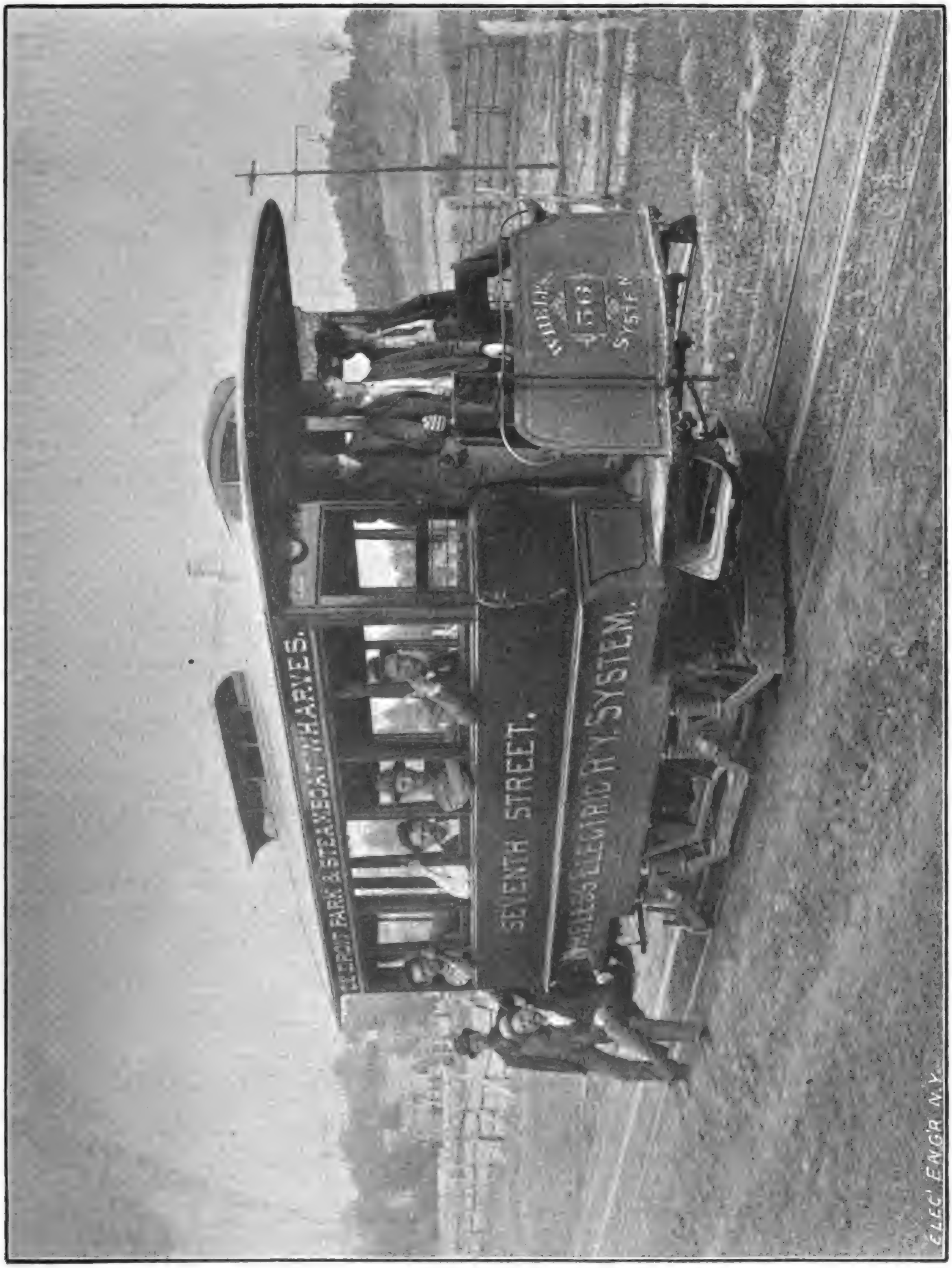


FIG. 1.—THE WHELESS CONDUIT ELECTRIC RAILWAY SYSTEM, WASHINGTON, D. C., SHOWING CAR, CONDUIT, ETC.

Fig. 7. This cut-out is placed under the bottom of the car, and is indicated at c, in the diagram, Fig. 4. Its use, as already explained, is to open the battery circuit on the car after the storage battery which the car carries has performed the function of raising the armature in the switch-box, letting in the main line current to the motor. The main line current, on entering the motor, passes around the magnet, and, drawing up the armature, cuts the local line at c, and holds it open as long as there is any current passing through the motor; in other words, as long as the car is moving.

To stop the car the rheostat must be thrown off, as usual, and when this is done the power current is cut, and, of course, the magnet, shown in Fig. 6, becomes dead and the local line is closed again. The local circuit would then immediately draw up the armature in the switch-box again if it were not for the fact that the local line on the car is still held open by the rheostat arm. When the latter is again thrown on to start the car, it plugs the local, and the car is at once started, as already explained. A sectional end view of the conduit employed in the Wheless system is shown in Fig. 3.

As will be seen, the conduit yokes are seated upon the cross-ties, the rails being elevated to convenient heights by the steel saddles which support them. The conduit is built

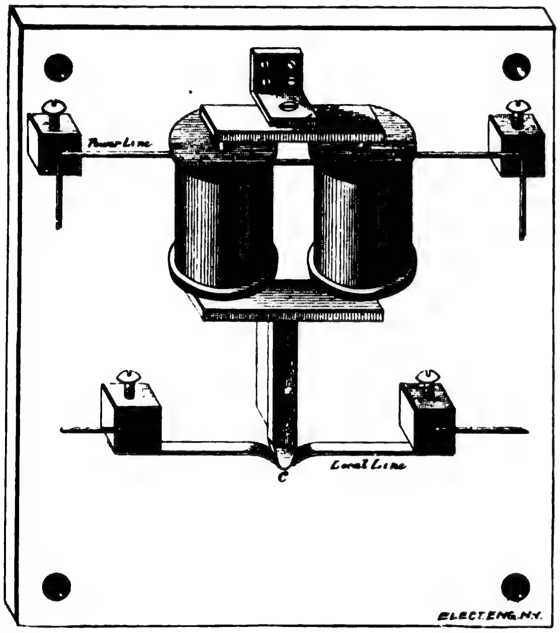


FIG. 7.—LOCAL CUT-OUT ON CAR.

with suitable drains, at convenient points; the drains also passing under the switch-box at the side of the track. The body of the yoke which rests on the tie is made of cast-iron, faced with steel angle plates bolted to the top of the yoke and supported by strong bars laid out to arms extending from the side of the yoke. The conduit has openings at convenient points for entering it and removing accumulations of dirt.

Recent tests of this system in its practical workings show a car of great power and efficiency. Fifty-two men were placed on the car and it ascended the 11 per cent. grade at a speed of six miles per hour. The car was then stopped on the grade, and, on being started again, gathered its speed, with this weight upon it, inside of thirty feet.

Where heavy grades are to be ascended, a separate feeder cable can evidently be used on the grade, so that as soon as the car starts up the grade it ceases to take current from the cable supplying other cars on the route, thus preventing a drop in potential.

These details embody the main features of Mr. Wheless' system and present a solution of the railway conduit problem, which deserves consideration by those who look towards the general introduction of electric railways in our large cities. The trials which we witnessed ourselves, a few days ago, involved every condition of operation met with in actual practice and were made during the recent abnormally heavy rains. While also entirely free from the mishaps usually accompanying the demonstration of new work, these tests went to convince us that the early extension of electric railway work on the conduit system is now to be looked for.

ON THE DISCHARGE OF ELECTRICITY THROUGH GASES AND ON THE FALL OF POTENTIAL.[1]

BY A. HEYDWEILLER.

SIR WILLIAM THOMSON first observed that the difference of potential necessary to cause the passage of an electric spark through a gas (air) between very close, smooth electrodes, is not proportional to the distance between them, but increases more slowly than this distance. Maxwell gives two explanatory notes on this point. The author wishes to corroborate that one which states that this may be due to a condensation of the air at the surface of the conductors, so as to produce better insulation, the two condensed strata being brought up to one another when the two electrodes are very close. A further question is as to what is the result in a non-homogeneous medium, as, for instance, between the surfaces of concentric cylinders, or two spheres external to one another. In the numerous experiments made on this point, no attention has hitherto been paid to the fact that the greatest and least values of the fall in potential at discharge are easily calculated from the size and distance of the electrodes and from the residual potential. This calculation shows also that the maximum tension is not nearly the same in all cases; but the mean (so called, absolute) values of the fall of potential taking place at discharge at the two electrodes in all cases with increasing distance, shows an analogy with that taking place in homogeneous fields. The limiting value of the fall of potential increases with increasing curvature of the electrodes.

The conclusions to which the author arrives are :—

(1) It is possible to explain the peculiarity of fall of potential on a spark passing through air between smooth electrodes, on the supposition of air being absorbed on the electrodes; but they must be larger than this layer of condensed air; further, it decreases with increased curvature.

(2) The mean fall (*i. e.*, the arithmetical mean of the differences at both electrodes) is, in non-homogeneous, as in homogeneous, fields, independent of the distance.

(3) The mean fall increases with increased curvature.

(4) From this mean fall, the maximum charge of a sphere in air may be calculated.

ELECTRIC RAILROADING AT COLORADO SPRINGS.

The Colorado Springs Rapid Transit Railway Company are rapidly completing their system of electric railways, the greater part of which is suburban. Four lines of single track road radiate from the centre of the city to the following points:—Rosswell, 3⅛ miles; Austin Bluffs, 5 miles; Cheyenne Canon, at the foot of Cheyenne Mountain, 5.4 miles; Manitou Springs, at the foot of Pike's Peak, 6 miles; Spruce street extension, 1¼ miles; besides which there is a city loop. The total mileage of the system will be about 22 miles. The power station has an aggregate capacity of 300 h. p. and consists of 2 Heine Safety boilers, each of 150 h. p. capacity, fitted with Murphy's patent grate setting and stoking device; 2 Allis-Corliss engines, each of 150 h. p. capacity, belted directly by means of link belting to line shafting, fitted with Hill patent clutches, driving four 50,000 watt Edison generators. Eighteen motor cars are in use. All lines are completed, except the Manitou, which is at present only operated to Colorado City, 2⅛ miles distant, but work is being pushed rapidly and will be completed in 30 days.

1. *Wiedemann's Annalen.*

ELECTRICAL ENGINEERS.

CARL HERING.

Carl Hering, B. S., M. E., was born at Philadelphia, Pa., in 1860, and is one of the five sons of the late Dr. Constantine Hering, the well-known founder of homœopathy in America. He is of German descent; his parents were born in Germany, but lived in America the greater part of their lives. He received his collegiate education at the University of Pennsylvania, in Philadelphia, entering in 1876. Physics and mechanical engineering were his favorite branches. He took the course in mechanical engineering under Prof. Wm. D. Marks, and graduated with honors in 1880, taking the degree of Bachelor of Science and Mechanical Engineer.

In 1881, he was elected Instructor in Mathematics and Assistant in Mechanical Engineering in the University of Penna., which position he relinquished a year later to become Assistant in Physics in the same University under Prof. George F. Barker, at that time one of the principal consulting electricians of the Edison Co. His object in taking this position was to study electrical engineering, which was, at that time, just beginning to become an important branch, but which was not yet being taught anywhere as a special course. While there, he published his first article, a table of equivalents of electrical and mechanical units of measurement. A year later he decided to go abroad to study the subject there. He was at that time (1883), elected Commissioner of the Franklin Institute of Penna., to the International Electrical Exhibition at Vienna, at which exhibition he was made an active member (the only one from the United States) of the International Jury, or Scientific Commission as it was called, who undertook the elaborate scientific tests of the exhibits. This work, which was started on very elaborate plans, continued several months after the closing of the exhibition. Thence he went to Darmstadt, in Germany, to continue his studies in electrical engineering at the Polytechnikum, under Prof. Kittler, who had been one of the principal experts at the Vienna Exhibition tests. This college was at that time one of the few institutions where electrical engineering was being taught as a special course. Shortly after beginning study there, Prof. Kittler appointed him his assistant, which gave him additional facilities for experiment and research. In 1884, he returned to the United States to become acting electrician for the International Electrical Exhibition in Philadelphia, held under the auspices of the Franklin Institute. He was also made one of the active members of the Scientific Commission appointed to make the tests and reports of the exhibits. In the latter capacity he urged the importance of a comparative life test of incandescent lamps, which had been wanting in the Munich and the Vienna tests to make them of value. Though this test was at first opposed and ridiculed by many of the prominent and well-known members of this Commission, it was finally started by Mr. Hering, through the efforts and aid of Prof. Marks, who appreciated the importance and value of such a test and who did not fear the work involved. Owing to the elaborate preliminaries and the repeated delays, the tests were not started until after Mr. Hering's departure abroad, on business, but they were subsequently carried out on much more elaborate plans through the untiring efforts of Prof. Marks, assisted by others. These tests, now well known as the Franklin Institute Duration Tests, remain the only ones of the kind that were made at an exhibition. Among the new testing instruments prepared by Mr. Hering at this exhibition was a galvanometer for measuring volts with an accuracy of one-tenth of a per cent. and a range of from 1 to 3,000 volts; also a means of measuring a current of 3,000 amperes, from the Forbes unipolar machine. In the fall of 1884, he returned to Germany to become electrical engineer for one of the large firms there. He then returned to Philadelphia, as consulting electrical engineer for a large company there, after which he started a practice of his own in that city, which he carries on down to the present time. In 1886 and 1887, he took charge, temporarily, of the course in electrical engineering at the University of Penna. In 1889, he was sent to Paris by the United States government to make the report on the electrical exhibits at the Paris International Exposition. Here he was made one of the two United States members of the International Jury, to award the prizes in Class 62 (Electricity), his very able colleague being M. Abdank-Abakanowicz. He was also elected delegate from the Franklin Institute to this exhibition for the class "Electricity," and was one of the representatives of the American Institute of Electrical Engineers, at the International Electrical Congress in Paris. At the close of the exhibition, he received the decoration "Officier de l'Instruction Publique," known as the "Gold Palms," from the French Government. In the spring of 1890, he was elected by the American Institute of Electrical Engineers as the representative whom they were asked to appoint, to act as one of the committee of three judges to award the prizes at the St. Louis Electrical Exhibition of 1890.

Carl Hering.

In addition to practising as a consulting electrical engineer in Philadelphia, Mr. Hering is devoting himself specially to testing and general expert work. He is the author of a number of papers and tables on electrical subjects, and of two books on dynamos. He is the inventor of several improvements in dynamos and storage batteries. He will be remembered by our readers as one of the oldest contributors to The Electrical Engineer, His valuable book on "Dynamo Electric Machines" is based on articles that appeared in these pages.

CARTY'S BRIDGING BELL SYSTEM FOR TELEPHONE LINES.

The system of bridging bells invented by Mr. J. J. Carty, the electrician of the Metropolitan Telephone Company, which was explained in his address on the subject at the recent Detroit telephone convention, deserves more than the passing notice which, pending diagrams and more explicit details, was contained in our report of the proceedings of the convention.

The practices which have been so successfully applied in telegraphy were at first applied to telephone circuits, but by no means with the same result, and no more striking instance of the different needs of the two branches of electrical engineering is afforded than in the arrangement of a number of stations on one line. As Preece says, in his

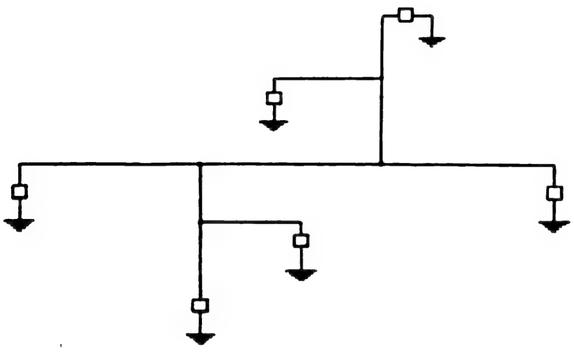


Fig. 1.

work on the telephone, "Nothing is easier than to place several telegraph stations on the same wire, while in telephony the conditions are entirely altered." The ordinary practice in telegraphy is to loop the various stations in the line, and this has been tried in telephony, with the result that the limit of speaking was soon reached, owing to the immense amount of resistance thrown in circuit with the addition of each additional magneto-bell, the counter E. M. F. of the magnet coils of course vastly increasing the actual resistance of the wire in the instruments. The bridging system has also been tried, but still with unsatisfactory results, and it has remained for Mr. Carty to design a bell—for here lay the crucial point of the problem—which permits of a far greater number of stations being placed on one line than has hitherto been attempted, and with the most successful results as regards both speaking and ringing.

In planning his magneto—which is now known as the "Metropolitan" bridging bell—Mr. Carty has kept in full view the peculiarities of the alternating current and the beauties of multiple arc working, which have been so thoroughly taken advantage of in electric lighting. The essential points of the bell are that the generator armature is wound to a very low resistance, the loss in E. M. F. which would otherwise follow being avoided by employing extra strong permanent field magnets, and that the ringer magnets are wound to a thousand ohms actual resistance with No. 33 wire, involving a great number of convolutions and, consequently, a high coefficient of self-induction. In this way the resistance of the bell circuit to the telephonic current may be 10,000 ohms, or even higher, and it is obvious that, even though every station on the line is connected so as to form a shunt across from one arm of the circuit to the other, it is a shunt of such an enormous resistance as compared with that of the speaking circuit that the talking is in no way impaired. The resistance of the speaking circuit may be considered as merely the resistance of the line plus that of the receivers and one transmitter secondary coil, as the other can always be cut out by the listener by means of the button provided for that purpose. It will be noticed that in planning out his system Mr. Carty has improved upon the ordinary multiple arc circuit as found in electric lighting, as every station on a line equipped with bridging bells is not only a receiving station but also a transmitting station; if such an arrangement had been proposed a short time ago probably few would have thought it possible.

The accompanying Figs. 1 and 2 illustrate the application of the bridging bell to both grounded and metallic circuits. On lines of either class, the bell is working with the best of results. In New York city several important private lines, one of them containing as many as twenty stations, have been equipped in this manner. All of these lines are busy throughout the day, and the users are highly satisfied with the clear speaking. In San Francisco an iron wire fifty miles long, containing eight way stations, was formerly arranged on the looping-in system, and it was impossible to speak from end to end of the line. The bridging bell has lately been applied to this very sick telephonic patient, the bells being legged on to ground as shown in the diagram, and the way line now works as well as the through line which is run on the same poles. It would appear also that the bridging bell is a panacea for all telephone complaints, as the reports in this instance state that, whereas with the old arrangement there was considerable trouble from cross-talk between the two wires, now there is but very slight induction.

An item of considerable importance which is liable to be overlooked in discussing the electrical advantages of the bridging bell is the saving, brought about by its adoption, in the expense of construction and maintenance of lines. As a general rule, when a number of stations are to be connected in one line they are so scattered that the most convenient method of reaching them is to run branches out from certain centres, generally local exchanges, the route of the main part of the line being determined by that of

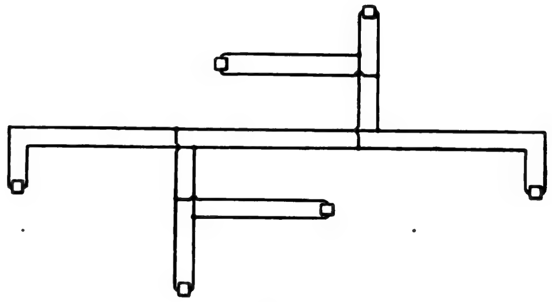


Fig. 2.

the trunk lines or underground cables belonging to the general system. With the stations looped in it would obviously be necessary, in the case of a grounded circuit, to run two wires, one lead and one return; or, if a metallic circuit, four wires would be required. With the bridging system only one wire is used in the first case and two in the second, as is shown very clearly in the diagrams. Consequently, there is a great saving in cost of material and construction, and also in maintenance, and Mr. Carty's device possesses the double advantage of being vastly more efficient than the methods it supplants, and also considerably more economical.

THE MONTE SAN SALVATORE ROAD.

A steep cable railway has lately been built up the slopes of Monte San Salvatore, near the Lake of Lugano, Italy. The power for working is obtained from a stream in the vicinity, and is transmitted electrically to the operating station. The water is led through a long iron pipe to two Girard turbines coupled direct to Oerlikon dynamos. The road is about a mile long and has grades varying from 17 to 60 per cent.

THE INTERIOR CONDUIT SYSTEM AND RULES IN PHILADELPHIA.

THE method of wiring buildings by means of the interior conduit system has attracted considerable attention in Philadelphia among electrical engineers, architects, insurance inspectors, owners of property, and others. The Interior Conduit and Insulation Co. has recently found it necessary to establish an agency there, in charge of Mr. B. Frank Johnson, and we are glad to have the opportunity of showing here the very handsome and striking sample board that he has placed in his office in the Provident Building there. It is a graphic representation of the system, as run through any building, and the samples displayed on the lower panels illustrate the different finishes that the tube is capable of receiving, such as old oak, brass, copper, nickel, china gloss, etc.

Taps. A separate tube must be laid for each wire except in case of "taps" or "branches" for not more than fifteen (15) amperes; in which case conductors having only a cotton insulation separating them will be required.

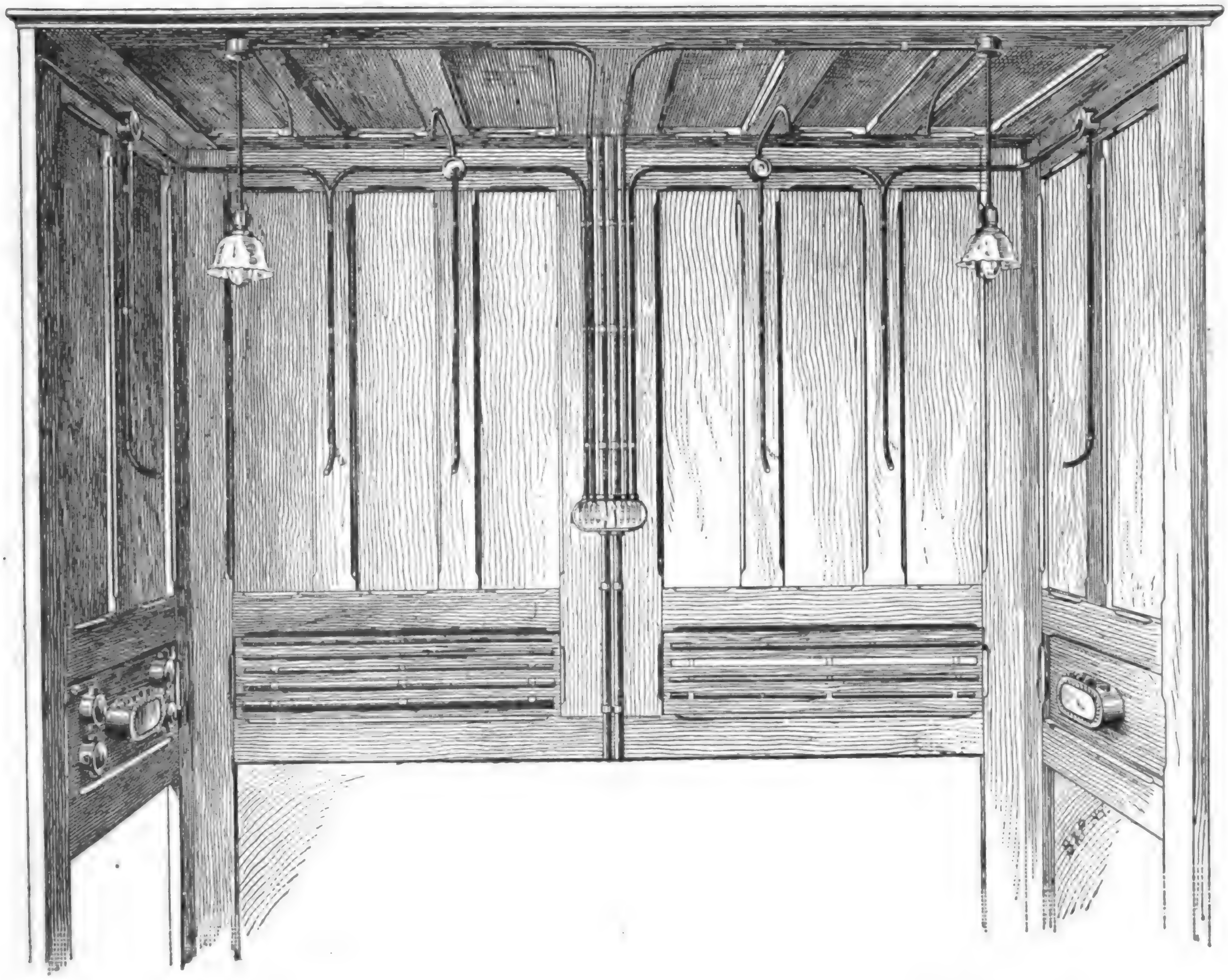
Wire. Rubber-covered wire must not be placed in the conduit where two (2) wires of the same or opposite polarity are run in the same tube.

Conduit. The conduit must be continuous from one junction-box to another, or to fixtures or switches.

"Clips." The tubing must be held in place by brass "clips" and in no case will staples be allowed.

Outlets. At all outlets the tubing must project through the plaster at least one inch and the tube left in such a way as not to be disturbed by the plasterers.

Joints. All the joints are to be made with the insulating compound of the Interior Conduit and Insulation Co., and carefully "wiped," so as to prevent moisture from entering. "P. & B." paint or any other material than the compound named must not be used. Before making joints the ends of the tube must be cut perfectly square so that they will butt together.



BOARD ILLUSTRATIVE OF THE METHODS AND DETAILS OF THE INTERIOR CONDUIT SYSTEM.

In connection with this work in Philadelphia, a very important set of interior conduit specifications have been drawn up and put into force, with the approval of the Philadelphia Board of Fire Underwriters; and as the matter is one of such general and vital interest, we print them below in full:

System. The building is to be electrically conduited and the conduit system of the Interior Conduit and Insulation Co. to be used throughout the entire building.

Sections. The building is to be divided into —— sections, as marked on the plans, and a separate set of tubes run for each "riser" in each section for the mains, said tubes to be one inch inside diameter.

Size of Tube. All tubing must be of sufficient size and so placed that the wires may be drawn, withdrawn and re-inserted at will.

Elbows. No more than four (4) elbows will be allowed between outlets, and should it become necessary to have more than four (4), an intersection box must be used. After the tubing is completed between outlets, a fishing wire, with a ball attached to the end, must be inserted, so as to make sure that no compound obstructs the tube.

Junction Boxes. Four (4) circuit main junction boxes are to be placed in each section on each floor throughout the building and from which all "taps" or "branches" in that section are to run.

Cut-outs. Four (4) circuit porcelain cut-outs are to be used. These cut-outs are to be placed in the junction

boxes and each branch wire leading from the cut-out must be protected by a safety fuse.

Inserting Wires. After the building is electrically conduited and before inserting the wires, powdered soap-stone must be blown into the tubes.

Inspection. The Conduit System, when completed, must in every way pass the inspection of the Philadelphia Board of Fire Underwriters, or, if so requested, the same to be inspected and passed by the Conduit Co., or both.

SWINBURNE'S "HEDGEHOG" TRANSFORMER.

BY NIKOLA TESLA.

SOME time ago Mr. Swinburne advanced certain views on transformers which have elicited some comment. In THE ELECTRICAL ENGINEER of Sept. 10. there are brought out further arguments on behalf of his open circuit, or, as he calls it, "hedgehog" transformer, claiming for this type a higher average efficiency than is attainable with the closed circuit forms. In regard to this, I say with Goethe, "Die Botschaft hör' ich wohl, allein mir fehlt der Glaube—I hear the message, but I lack belief."

Many of Mr. Swinburne's arguments are in my opinion erroneous. He says: "In calculating the efficiencies of transformers, the loss in the iron has generally been left completely out of account, and the loss in copper alone considered; hence, the efficiencies of 97 and 98 per cent. claimed for closed iron circuit forms." This is a statement little complimentary to those who have made such estimates, and perhaps Mr. Swinburne would be very much embarassed to cite names on behalf of his argument. He assumes the loss in the iron in the closed circuit forms to be 10 per cent. of the full load, and further "that in most stations the average use of lamps is less than two hours a day, including all lamps installed," and arrives at some interesting figures in regard to efficiency. Mr. Swinburne seems not to be aware of the improvements made in the iron. The loss with the best quality of iron will, I believe, not reach 6 per cent. of the full load by an intelligent use of the transformer, and there is no doubt that further improvements will be made in that direction.

As regards the second part of his assumption, I think that it is exaggerated. It must be remembered that in most central stations or large plants due care is taken that the load is favorably distributed and in many cases the wiring is such that entire circuits may be shut off at certain hours so that there is during these hours no loss whatever in the transformers.

In his "hedgehog" form of transformer Mr. Swinburne reduces the iron considerably and comes to the conclusion that even in small transformers the iron loss is under one per cent. of the full load, while in the closed circuit forms, it is, according to him, 10 per cent. It would strengthen this argument if the iron would be dispensed with altogether. Mr. Swinburne does not appreciate fully the disadvantages which the open circuit form, operated at the *usual period*, entails. In order that the loss in the iron should be reduced to one-tenth, it is necessary to reduce the weight of the iron core to one-tenth and subject every unit length of the same to the same magneto-motive force. If a higher magneto-motive force is used the loss in the core will—within certain limits, at least—be proportionate to the *square* of the magneto-motive force. The remark of Mr. Swinburne, "If the iron circuit is opened, the sides of the embracing core can be removed, so the loss by hysteresis is divided by three," is therefore not true; the loss will be divided by $3 \times \frac{F^2}{F_1^2}$ where $F_1 > F$. If the iron of the open circuit form is made up in a closed ring the advantage will be at once apparent, for, since the magnetic resistance will be much reduced, the magneto-motive force required will be correspondingly smaller. It is probable that, say, four Swinburne transformers may be joined in such a way as to form a closed magnetic circuit. In this case the amount of iron and copper would remain the same, but an advantage will be gained as the total magnetic resistance will be diminished. The four transformers will now demand less excitation and since—under otherwise equal conditions—the gain depends on the square of the existing current, it is by no means insignificant. From the above comparison it is evident that the core of such open circuit transformer should be very short, by far shorter than it appears from the cut in THE ELECTRICAL ENGINEER.

Mr. Swinburne is in error as to the motives which have caused the tendency to shorten the magnetic circuit in closed circuit transformers. It was principally on account of practical considerations and not to reduce the magnetic resistance, which has little to do with efficiency. If a ring be made of, say, 10 centimetres mean length and 10 square centimetres cross-section, and if it be wound *all over* with the primary and secondary wires, it will be found that it will give the best result with a certain number of alternations. If, now, a ring is made of the same quality of iron but having, say, 20 centimetres mean length and 10 square centimetres section it will give again the best result with the *same number of alternations*, and the efficiency will be the same as before, provided that the ring is wound *all over* with the primary and secondary wires. The space inside of the ring will, in the second case, be increased in proportion to the square of the diameter, and there will be no difficulty in winding on it all the wire required. So the length may be indefinitely increased and a transformer of any capacity made, as long as the ring is completely covered by the primary and secondary wires.

If the wires be wound side by side the ring of smaller diameter will give a better result, and the same will be the case if a certain fraction of the ring is not covered by the wires. It then becomes important to shorten the magnetic circuit. But, since in practice it is necessary to enclose the transformer in a casting, if such a ring be made, it would have to be protected with a layer of laminated iron, which would increase the cost and loss. It may be inclosed in jars of some insulating material, as Mr. Swinburne does, but this is less practicable.

Owing to this, the constructors of the most practical forms, such, for instance, as the Westinghouse transformer, to which the Swinburne reasoning applies, have been prompted to enclose the wires as much as possible with the laminated iron, and then it became important to shorten the magnetic circuit, because in this form only a part of the magnetic circuit is surrounded by the wires, as well as for other practical considerations.

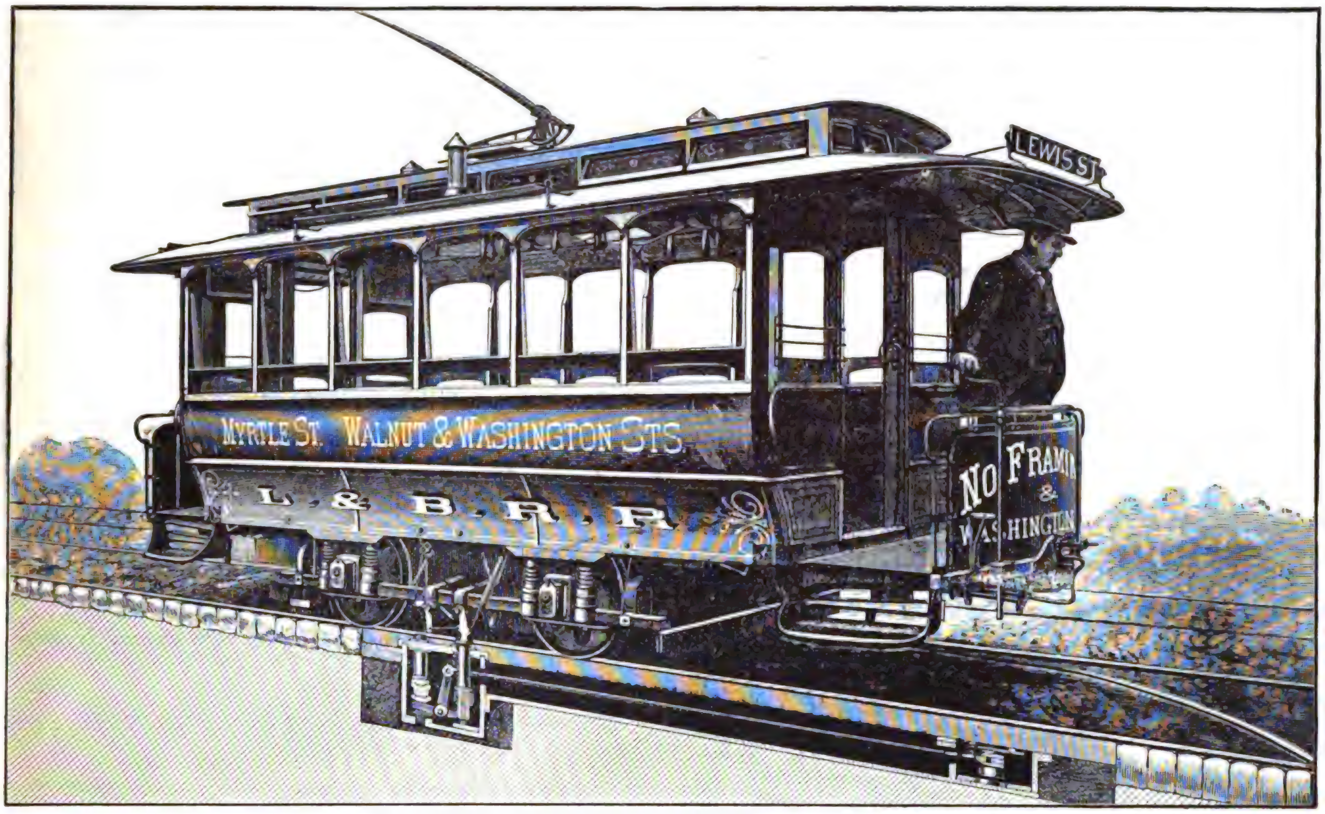
In practice it is desirable to get along with the least length of copper conductor on account of cheapness and regulation. Mr. Swinburne states that in his transformer the loss in iron is under one per cent. of the full load; all the balance of loss must, therefore, be in the copper. But since, according to him, the wires are of larger section, his transformer can hardly be an improvement in that direction. The gun-metal casting is also objectionable. There is no doubt some loss going on in the same, and besides it increases the resistance of the wires by a factor $\sqrt{\frac{S}{S_1}}$ where S is the total cross-section of the core and S_1 the section of the iron wires. There is one important point which seems to have escaped Mr. Swinburne's attention. Whether the open circuit transformer is an improvement, or not, will depend principally on the period. The experience of most electrical engineers has resulted in the adoption of the closed circuit transformer. I believe that I was the first to advocate an open circuit form, but to improve its efficiency I had to use a much higher period; at usual periods the closed circuit form is preferable.

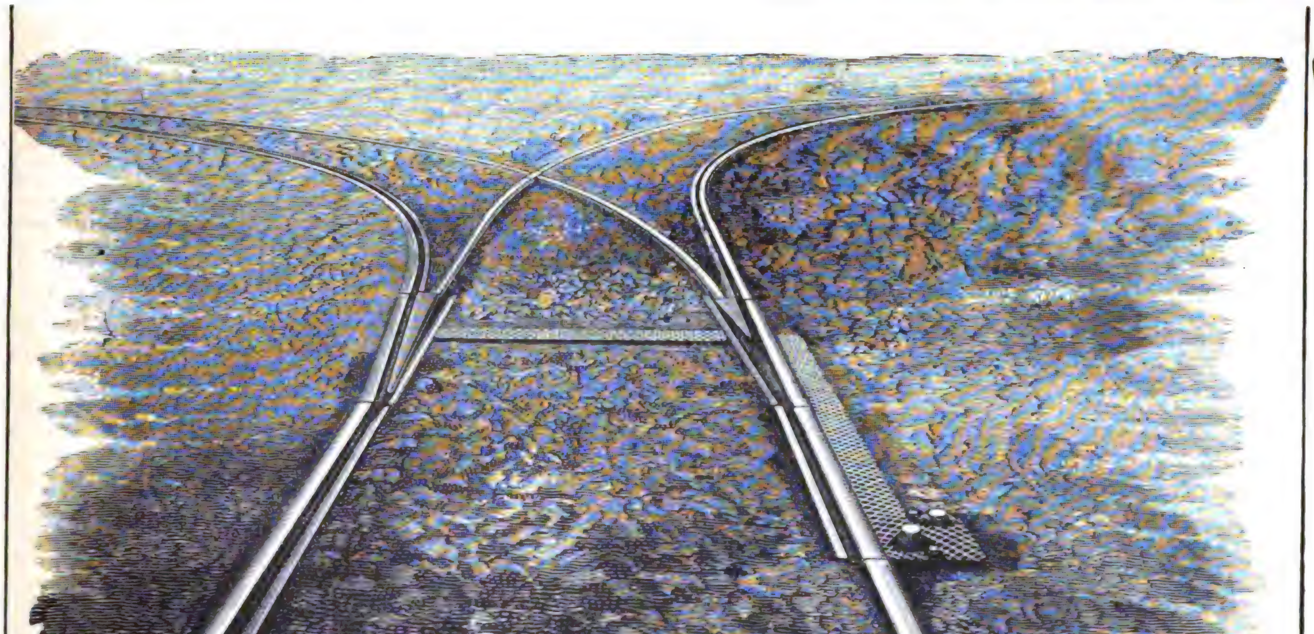
Mr. Swinburne makes some other obscure statements upon which I need not dwell, as they have no bearing on the main question.

THE ROWELL AUTOMATIC STREET RAILWAY SWITCH.

We illustrate on this page an interesting and useful device which has now been in successful operation on the Lynn & Boston Railroad Co.'s electric line, for a period of over eighteen months, and including two winters. It is of simple and durable construction, costs little for installation, and is under easy and complete control of the driver.

The switch is operated by two upright arms or plungers, in a box at the right-hand side of track. These upright arms or levers are connected to arms upon a rock shaft, which moves the switch tongue by a rod and crank. The plungers referred to are operated upon by either of two arms, the lower end or tread being a segment of a circle hung from the axle box, or the bar connecting them, and when not in use, are drawn up close to the truss of the car, by a spring, and are brought into an upright position, so as to strike the plunger and set the switch, by a lever in front of the driver, to be operated by the hand, or a pedal attached to the lever, as may be preferred.





Figs. 1 and 2.—The Rowell Automatic Switch as Used on the Electric Road, Lynn, Mass.

Fig. 1 represents an electric car in the act of setting the switch; also a longitudinal section of the switch mechanism. It will be noticed that the switch-setting attachment on the car is hung below the springs, on the bar connecting the axle boxes. This always remains at a fixed distance from the track. The arm always strikes the plunger,

and the movement of the switch-tongue is positive and sure. On this car the motorman brings the arm in position by a pedal.

Fig. 2 represents a section of road-bed with a left-hand switch, with cross connection in position, at the corner of Washington and Boston streets, Lynn. The box containing the switch mechanism is always placed on the right-hand side of the track, but the left-hand switch requires a cross connection, as above. This switch is being introduced by the Rowell American Switch Co., of Boston.

ELECTRIC STREET RAILWAY MOTORS.[1]

BY JOHN W. M'NAMARA, PRESIDENT ALBANY STREET RAILWAY.

SOON after the road-bed of the Albany railway was completed, and during the summer of 1864, when the directors and projectors of that road often saw four horses vainly endeavoring to draw the passengers contained in a twelve foot car up a grade of eight per cent. on State street, their attention was very naturally turned to the solution of the problem of transmitting the power of steam to the car.

Device after device was tried, but all proved failures, but still the directors never lost hope that at some time the problem would be solved. The successful use of the cable in San Francisco stimulated the stockholders to an effort to secure capital enough to construct a cable road; but the large amount of capital necessary to lay a cable road, and the want of faith in its working in this climate during the winter months, proved formidable obstacles.

More than twenty years had passed since the road was opened, and horses were still being used to draw the cars, when the attention of the managers of the road was called to certain experiments made by Mr. Leo Daft, who had for many years been a resident of two adjacent counties. Those of the managers who saw what the Daft electric motor did, felt that the day of emancipation for the State street car horses was rapidly drawing nigh. The experimental roads which are familiar to us all were earnestly examined, and the time when the obstacles to smooth operation would be overcome hopefully expected.

The time came much sooner than the most sanguine of us dreamed of; Baltimore, Scranton, Meriden, Richmond, Hartford and Boston followed in rapid succession, Scranton and Meriden demonstrating that it was possible to operate electric motors in winter. Our sister city, Troy, joined the electric band, and our sister company, The Watervliet Turnpike and Railroad Company, also contracted for electric equipment, before the Albany Railway could determine which of five systems was the best and make a contract. It was finally made with the Thomson-Houston Electric Company on the 30th day of November, 1889, and cars began running on the State street line April 28, 1890, and on May 1st all the horses on that line were withdrawn.

None of our drivers had had any training until the evening of April 27, 1890, yet we were able to begin running schedule trips with three cars the next day. Over four months' experience has taught us that the electric motor is efficient and reliable. We have yet to learn, by experience, that it will ascend State street an eight per cent. grade at the rate of five miles per hour in winter, as it has during the summer. We have also to learn, by experience, for it seems to be impossible to learn it in any other way, whether operating cars by electricity is more economical than by horses.

At the time of the introduction of the electric motor, the ordinary street car drawn by horses was the most convenient vehicle in public use. It was easy to enter one and easy to alight from one. The various makers had vied with each other, until one was able to step as easily from the street into a car, as he could ascend two steps of his own stairs. The early builders of electric cars endeavored to retain this feature of the street car, and placed the motor proper *on* the car, communicating motion to the axles by means of sprocket chains and wheels; but the mechanical difficulties, and the noise made by the chains and wheels led to their abandonment, and the motor or motors were then placed on the axles and *under* the car, where we find them to-day.

At first the easy-of-access feature was retained, but as the necessity for larger motors and more room for them became apparent, the car body was gradually raised until it is too high for children and elderly people to enter readily and a great deal of time is consequently used in receiving and discharging passengers.

The car body has been raised at the expense of comfort without, it seems to me, improving the condition of the motor. It is still under the car, near mud, dust, snow and slush, and is as difficult to get at as it ever was.

With these exceptions the electric motor of to-day is well nigh perfect, but these exceptions, as time goes on, will become more serious. When the novelty of being regularly and rapidly carried to their homes and places of business ceases, then passengers will call attention to the difficulty of entering and leaving cars.

The size of the motor, especially for use on grades, should not exceed the standard—sixteen feet for box cars and about twenty-five feet for open cars. On level and suburban roads, where the headway is not less than twenty minutes, larger cars with eight wheels might probably be economically used; but for populous cities where headway is less than five minutes, the old standard car body is, in my opinion, the best.

How the motor is to be arranged with reference to the car body so as to admit of easy access to it for examination and repair may, or rather must, be left to mechanical and electrical engineers. That we will continue to drag them in the dust and mud very long I cannot believe.

I think the opinion of all who are unprejudiced is, that the overhead single trolley under contact systems are the most reliable and efficient. With good overhead construction the loss of power in transmission is but slight, and the conductors are always where they can be seen and kept in place.

The ideal motor is one which is independent of every other motor or other engine, and contains everything necessary to make it go. This motor exists and seems to work fairly well on grades of not more than five per cent; but that it is capable of doing the work now being done by motors of overhead system is still problematical. However, as we have already witnessed such wonders in propelling cars by electricity, may we not hope for a storage battery electric car which shall be equal to any now in use?

We are justified, I think, in recommending to all who think of changing from horse to electric motors, or to all who think of building new roads, the overhead single trolley system. All the manufacturers of motors and generators have their systems in use in cities which can be readily visited, and the merits of all can be compared.

The question as to whether the electric motor is as economical as the horse car cannot yet be answered, and need not be answered. Just as certainly as the horse car supplanted the omnibus, the electric motor will supplant the horse car. The horse car, however economical, must go, and the electric motor, no matter how expensive, must come.

1. Read before the New York Street Railway Association, Rochester, Sept. 16, 1890.

ON THE NEW STANDARD EDISON ELECTROLYTIC METER.[1]

BY A. E. KENNELLY.

SINCE the last meeting of the Association, the new and improved pattern of the Edison meter has been decided upon, received Mr. Edison's approval, and has been completed by the Edison General Electric Co. It has already been introduced into two stations, Brooklyn and Winnipeg, and the reports upon its behavior in each case are excellent.

There are four standard sizes of these 3-wire meters, Nos. 1, 2, 4 and 8; designed to supply 40, 80, 160 and 320 lamps respectively. Meters of larger capacity than these are made specially. In all sizes, however, the bottles and plates are alike and of the pattern shown; the spools are alike, making the resistance of the bottle circuit the same in every meter, and the drop of potential in the shunt at full load is the same; namely, four-tenths of a volt.

It is arranged that in the smallest, or No. 1 meter, each milligramme of weight transferred represents one ampere hour of supply, and the transfer is ten milligrammes per hour on full load. Similarly, every meter transfers ten milligrammes per hour at full load, so that each milligramme of transfer in a No. 8 meter represents 8 ampere hours, and in a No. 4 meter, 4 ampere hours, the number of the meter being the index of the supply in each case.

This greatly simplifies the system, reduces the weight of bottles that have to be daily transported, reduces the stock that the station has to keep on hand, makes only one balance requisite instead of two, and with reasonable care the use of a separate multiplier for each size of meter is not found to be an inconvenience. The objection has been urged against the system that there is danger in making one milligramme of transfer stand for so large a unit as 8 ampere hours in the No. 8 meter, since an error in weighing, or in the proportions of the meter, would result in an error in the bill eight times as great as the same discrepancies would produce in a No. 1 meter. Even granting the validity of the objection, however, it is evident that since meters are introduced in the capacity proportionate to their duty, the error in the No. 8 meter bill will only bear the same ratio to the whole amount charged, that the smaller No. 1 error bears to its bill. As a matter of experiment, however, taking, for instance, a series of tests made with the meters by Mr. R. S. White at Brooklyn, the records of a set of Nos. 1, 2, 4 and 8 meters worked in series and at intervals for a week on half load for the smallest, or five amperes, one-sixteenth of the load for the largest, showed

1. A paper read before the Assoc. of Edison Illum. Co.'s, Minneapolis.

practically the same result, the No. 8 meter under-indicating about 2 per cent.

This high degree of relative accuracy, setting aside all question of care and skill, is secured by three things. The first is a higher degree of absolute accuracy in general. The old pattern meter is universally admitted to be a faithful and accurate instrument, but the intrinsic accuracy of the new pattern is about three times as great. The only chance for error in the operation of the electrolytic meter, accidents aside, is the variation of resistance in the bottle, whereby the true ratio between the currents in the bottle and shunt circuit is upset. The extent of such a disturbance, of course, depends upon the relative proportions of resistance in bottle and spool. Suppose it were possible for the new bottle to even double its resistance and to become 5 ohms instead of 2.5 at normal temperature. In circuit with a spool of 46¼ ohms, such a change would only upset the balance and make the record in defect 5 per cent. In the old pattern meter, the doubling of the bottle resistance, were such a variation to be expected, would make the readings 15 per cent. in defect.

The second preventive of error in the larger sizes is due to the uniformity in the size of plate. A cause of discrepancy has always existed in a slight gain of the plates in weight independently of the current's action and due to their oxidation superficially. With care this source of error has always been minimized, but with the old meters it increased with the size of the meter, since a larger plate offered a larger surface to oxidization. In the new pattern it is, of course, a fixed amount in all sizes, and owing to the small area of plate is in any case very small.

The third precaution against error in the larger sizes is the use of duplicate bottles in the Nos. 4 and 8, as mutual checks which are not required in the Nos. 1 and 2.

Another improvement is in the plates. These are castings of pure zinc alloyed with two per cent. by weight of pure mercury. This amalgam has the advantage of being more readily brought into good condition for use than the rolled plate; the trouble of varnishing is also saved. The only other noteworthy change has been in the solution, which is about twice as dense as in the old bottles.

Mr. Edison has recently completed a mechanical meter on the pattern of one of his early patents in that direction. This instrument is a small motor delicately constructed. The armature commences to rotate as soon as one lamp in the supplied circuit is turned on. The rotation accelerates as more lamps are lit, until, at the full load of 20 lamps, the speed is 600 revolutions per minute. A counter, worked from the armature shaft, records the number of rotations, and on duly proportioned dials, the supply. The field magnets are kept charged by a feeble current from the mains, while the main current passes through a shunt as in the electrolytic meter, and from the shunt terminal, wires pass to the armature. The drop of potential in the shunt at full load is 1.5 volt. The model, though complete in itself, will be slightly modified in detail to suit commercial use, and will then be available for such cases where a mechanical meter is desirable. Mr. Edison does not consider that a mechanical meter can possibly be as cheap or as reliable as the electrolytic meter, first, owing to the necessary frictional error, which makes the record too low for very light loads and low speeds; and, secondly, owing to the mechanical wear and tear of the working parts which will need attention and exchange from time to time; but there are cases in which a direct reading mechanical meter will be an advantage, and he expects that from the tests and behavior of this model it will serve the purposes.

CONCLUSIONS DRAWN FROM ONE YEAR'S EXPERIENCE WITH THE STANDARD EDISON METER.[1]

BY R. S. WHITE.

DURING the year's work with the new standard meter we have taken 4,088 incandescent, 853 arc light and 244 motor readings—a total of 5,185, and have obtained uniformly good results. In a large number of cases customers have kept tally of lamp hours—and in every instance expressed themselves as satisfied. A considerable number of tests have shown marked accuracy. The greater dispatch and care with which the meter work can be performed has been abundantly shown. The use of small and uniform plates secure, by the balance method, doubled accuracy in weighing and the elimination of the oxidation error. In brief, our experience with the standard meter shows improved ease and economy in operation with more uniform and accurate results. In so far as a chemical meter "fills the bill," little remains to be said.

It may be interesting to note the use of four Aron meters on our circuit for the past year. The frank, open countenances of these meters have won the favor of the meter man and the confidence of the customer. It is suspected also that the company would accept their advances with better grace were it not for their haughty treatment of the financial question involved.

We may conclude then that it is in the line of a direct reading dial meter that we are to look for the next advance in the commercial treatment of the meter question.

1. Read before the Association of Edison Illuminating Companies, at Minneapolis, September 17, 1890.

A NATIONAL CODE OF INSURANCE RULES AFFECTING ELECTRIC LIGHT AND POWER INSTALLATION.[1]

BY W. J. JENKS.

IT has often been noted as one of the evidences of the incomplete development of the present system of electric light and power construction that the rules enforced by the underwriters in different sections of the country are so widely different as to make it impossible for a construction firm in Boston to be at all certain of being able, without further education, to do work in Philadelphia acceptable to the insurance inspector, or for a supply man in Chicago to be sure that he is furnishing material which the underwriters of Cincinnati will approve.

From the time of the formation of the original rules for wiring of buildings for incandescent lamps (resulting from the conferences of the New York Board with the practical people of the Edison Company) to the present, all codes used by the insurance fraternity have, while annually growing nearer to a standard, embodied so many uncertain quantities and individual notions that it has been hard to predict what a year might bring forth in modification of existing requirements. Very much has been done by the earnest efforts of the inspectors of the New England Exchange, and the New York State Board, as well as by the practical labors of the Philadelphia fire patrol and the Chicago city officials; but it has been reserved for the present year to evolve a plan which promises to speedily revolutionize the chaotic condition of matters of this kind by harmonizing all the minor distinctions which exist in the codes heretofore enforced by the insurance inspectors of different sections in one National Code, which, by reason of the authority by which it is supported, will be adopted by a large majority, if not by the entire fraternity, of the insurance men in the United States.

At the Kansas City meeting, February last, the National Electric Light Association chose a committee for the purpose of conferring with the insurance people, and, if possible, of setting on foot such measures as might result in this uniform code. The action by which this committee was brought into existence is expressed in the vote taken at that session.

Pursuant to this plan the secretary of the committee, Mr. George Cutter, of Chicago, entered into correspondence with the representatives of the active executive insurance associations, and with the leading electric light companies of the country, and the result of his persistent and intelligent endeavors in this direction appeared at a meeting of the committee and the representatives of the two interests which convened at the Stockton Hotel, Cape May, August 16th, three days in advance of the first session of the convention of the National Electric Light Association.

The committee held its first meeting on Saturday evening, Mr. Cutter in the chair, and the names of the remaining gentlemen present were as follows:

C. M. Goddard, inspector New England Insurance Exchange, Boston, Mass.; E. C. North, chairman electric light committee, New England Insurance Exchange; S. E. Barton, president of the Electric Mutual Insurance Company, Boston; Wm. Brophy, chief inspector Electric Mutual Insurance Company, Boston, and representative of the Mutual Fire Insurance Companies of New England; F. E. Cabot, inspector Boston Fire Underwriters' Union; W. H. McDevitt, inspector Philadelphia Fire Underwriters' Association; J. P. Barrett, city electrician, Chicago, Ill., and also representative of the Chicago Board of Fire Underwriters; W. A. Anderson, secretary New York Board of Fire Underwriters, and also secretary of the National Board of Fire Underwriters; W. De L. Boughton, chairman electric light committee, New York Board of Fire Underwriters; H. O. Kline, chairman of the electric light committee Underwriters' Association of the Middle Department, Philadelphia, Pa.; J. J. Babcock, chairman light committee Insurance Association of the State of New York, Binghamton, N. Y.; C. E. Bliven, chairman electric light committee, Western Union Fire Underwriters' Association, Chicago, Ill., and representatives of the Fire Underwriters' Association of the Northwest; J. S. Alfred, inspector Southern Tariff Association, Atlanta, Ga.; R. H. McMath, representative St. Louis Board of Fire Underwriters; J. R. Lovejoy, Thomson-Houston Electric Company, Boston, Mass.; P. H. Alexander, Westinghouse Electric Company, New York; W. J. Jenks, Edison General Electric Company, New York.

Mr. Cutter was chosen secretary, and the chairman stated the object of the meeting as being the securing of a harmony of ideas between the electric light and insurance interests.

An extended discussion of the proper basis of a code of generic or fundamental rules, extended through several sessions, and resulted in an outline representing practically the unanimous views of the gentlemen present. Exhaustive statements of the reasons for the positions assumed in this initial code were made by the electric light representatives and agreed to by the insurance inspectors as embodying the results of their experience. A special

1. A paper read before the Association of Edison Illuminating Companies at Minneapolis, September 16, 1890.

committee presented at the second session a code of by-laws as the basis of a permanent organization, which was, early in the deliberations of the meeting, decided upon as the only practical method of securing and perpetuating an influence sufficiently positive and controlling to be permanent. A concise summary of a few of these by-laws will illustrate the scope of the work to be done, the solidity of the basis upon which the organization was effected, and the standing of the insurance representatives composing the organization is a guarantee of that important work in that executive direction in which former efforts have been lacking.

The name decided upon was "The National Electric Insurance Bureau," and the object is stated by the by-laws to be "the harmonizing of the electric interests and the fire insurance interests in the United States."

It is also provided that in addition to the membership indicated by the names of those in attendance, one member may be chosen by the National Telephone Association, one by the Western Union Telegraph Company, one by the Postal Telegraph Company, one by the National Association of Fire Engineers, one by the Underwriters' Association of the Pacific Union States, and such other insurance representatives as may apply for membership, and be deemed eligible.

It was settled that as a method of completing an organization for the opening year, the gentlemen of the committee chosen by the National Association, and representatives of the other organizations above named, having been called together by the original committee, should be members of the bureau until the next meeting, or until their successors were chosen.

Officers were elected as follows: President, Major C. E. Bliven, Chicago; secretary and treasurer, George Cutter, Chicago; executive committee, Messrs. Bliven, Brophy, Lovejoy, Jenks, Anderson, McDevitt and Cutter.

A committee consisting of Messrs. Barrett, Goddard and McMath was chosen to gather information regarding city and state laws bearing upon electric interests.

After a very careful discussion of the best method of obtaining the primal object of the meeting, namely, a uniform code of rules which shall be national in their application, the following members were chosen a committee to outline such a code: Messrs. Bliven, Cutter, McDevitt, Cabot and Jenks.

The deliberations of the meeting consumed six sessions, and an adjournment was made on Monday evening, Aug. 18th, subject to the call of the president, or to the time of the annual meeting, which, by the by-laws, was fixed to be held sometime during August of each year at such day and place as the executive committee may determine.

The committee charged with the work of codifying rules were instructed to secure as many different sets of codes as may be at present in force by any of the State or local Boards throughout the country, and by such light and power companies as may have given careful thought to this matter. It is proposed that these shall be, if possible, harmonized and condensed, and that a draft embodying whatever may be desirable from all, be sent by the committee to the organizations from which the different codes emanated for criticism and suggestion. Also, that on return of such criticisms a final arrangement may be made, and an improved code, thus prepared, submitted to a future meeting of the Bureau for adoption.

It will at once be seen that from the fact that the large majority of the members of this Bureau are executive insurance officers, and that as they represent one hundred and fifty or more of the leading insurance companies doing business throughout the United States, the adoption of any code of rules by such a body will mean the immediate enforcement throughout the territory over which they have control. Copies will be at once sent to the representatives of these numerous companies, including agents and local boards, and the inspectors will be provided with the code as a method of instruction, simply forming an addition to their previous duty, for the general inspection of buildings, and thus a most effective plan of determining whether or not proper methods have been pursued will at once be adopted by the underwriters. Hence, by the operation of a logical and mandatory plan, a rigid surveillance will be exercised over all constructing firms, and a great advantage immediately gained by the application of a uniform standard throughout the country.

The significance of the action taken and the probable results may be better understood when it is remembered that this is the first systematic effort made to secure the adoption of a uniform code of rules by the executive managers of a large number of the different insurance organizations, represented by the several associations of the United States.

PHILADELPHIA TO NEW YORK IN 36 MINUTES.

Prof. Wm. D. Marks, engineer of the Edison Electric Light Company, of Philadelphia, an electrical expert, says he is willing to stake his reputation as an electrical engineer on his ability to construct an electric motor that could take a train of cars from Philadelphia to New York in thirty-six minutes. One hundred and fifty miles an hour is the speed Prof. Marks' motor would have to make.

SOME SPECIAL LAMPS MADE AT THE EDISON LAMP WORKS.[1]

BY F. E. JACKSON.

It is desired to call the attention of the managers of the Illuminating Companies and others, to a few lamps provided by the Lamp Works, which are designed for special uses; with the exception of the "small battery lamps" the lamps to be described have not long been on the market, and are but little known. The small low-volt lamps, which are made for use with primary batteries, have been manufactured for several years, and are more or less known to all, although comparatively few have been used in central stations; until recently comparatively few have been made, but now the demand is increasing rapidly.

The one purpose for which these lamps were made was, as their names indicates, for use with batteries, and particularly with primary batteries. The E. M. F. of the lamps is very low, varying from 10 to 12 v., in the 6 c. p. lamps to as low as 2½ v. in the small ½ c. p. lamp made for the use of surgeons and dentists; the E. M. F. is purposely made low so that the lamps can be used with the least number of cells of batteries. It should be noted that not less than two cells can be used with any of the lamps.

The lamps vary in candle power from ½ to 6 candles; they are also made of ½ candle power in the special forms of "dental," "surgical" and "pea" lamps. The efficiencies are high, as they should be where current is as costly as it is where primary batteries are the generators. The efficiencies average not more than 2 volts per candle.

It was stated that not many of these lamps had been used until within a short time; the reason, no doubt, is that they were not advertised in a way that would bring them to the notice of possible purchasers.

A small pamphlet descriptive of the lamps and of cheap batteries that can be used with them is now issued by the Lamp Works, and the lamps have lately been advertised more extensively in other ways; the results are easily seen in the number of lamps ordered. Also, there have been so many orders received for material for making the batteries described in the catalogue that it was decided to make up complete outfits, and these are now made and kept in stock. By securing a few samples and advertising them, the Illuminating Companies would find a sale for a good many lamps.

About a year ago there was a demand for small lamps suited for burning in series on the regular 110 volt lighting circuit. Before the time mentioned there had been no special demand for lamps to be burned in series, and no lamps had been made for that purpose. The "battery" lamps were used in this way in a number of cases, but they did not always give satisfaction; it was found that, to give the best results when used in this way, the carbon in the lamps should be made of different proportions and different dimensions.

The lamps then made for burning in series on the dynamo circuit have given very satisfactory results. They are the lamps which were used in the electrical exhibition at the Lenox Lyceum, New York, during last winter, and which are used here at Minneapolis Exposition, where they speak for themselves.

The "small series burning lamps" are made higher in voltage and of lower efficiency than the battery lamps. They are made in candle powers of 1 to 4 candles. The voltage of all lamps is about 14 v., so eight lamps of any one candle power can be burned in series on the 112 volt circuit.

The lamps are made of efficiencies varying in different lamps from 3 to 5 watts per candle. The lamps are tested and marked for the current takes when burning at normal candle power, and those taking the same amount of current are selected for burning in series together. The "series burning lamps" are made of lower efficiency than the battery lamps. When a dynamo is used as the generator the cost of producing current is low as compared with the cost of the current from a primary battery; therefore, high efficiency is not so great an object; also as the lamps are burned in series, the breaking of one lamp stops the flow of current in several others, making it appear as though the lamps broke more frequently than they actually do; the comparatively low efficiency of the "series" lamp is an advantage as the increased lamp life which comes with a decrease in efficiency reduces the number of renewals proportionally, and also presents the annoyance which would be the result if the lamps broke more frequently.

Some tests in order to determine the best efficiency to give these "series burning lamps" are now being made at the lamp factory. So far the results are very satisfactory. At the time of this writing only one lamp has broken. It broke at the end of 320 hours; the number of lamps burned in the test was twenty-two. Another set of thirty-three lamps have been burning for 250 hours and no lamps have been broken.

The lamp which it is believed will become the most popular one for decorative purposes and for producing scenic effects has not

1. A paper read before the Edison Association, Minneapolis, Sept. 16 and 17, 1890.

yet been used outside of the factory, the lamps having been made only during the past few weeks. The lamp referred to is the 1 c. p. 14 v. or "8 in series" lamp.

For use in fancy designs and in producing effects where it is the effect only, and not illumination, that is wanted, the result obtained with the 1 c. p. lamps are quite as good as those obtained with the lamps of higher power. The decided advantages in using the 1 c. p. lamps are, that less current is required than for the 3 and 4 c. p. lamps, and the heating effects are less also.

In the exhibition we have an illustration of some of the uses to which these small lamps can be put, but there are many ways in which they can be used with profit on a smaller scale by the Illuminating Companies. A profit can be derived from the sale of current to light them.

At the Lamp Works several different fancy designs have been gotten up when called for, in which the small lamps are arranged in the form of letters spelling words and names: the lamps have also been arranged in other forms, such as stars. With suitable switches, the lamps forming letters, words, or different parts of designs can be lighted or turned off at will, attracting the eye and producing pleasing effects. We think that there is a sale for a large number of such signs and figures for use in stores, large and small, and in hotels, etc.

The lamps are made of different colors. The colors in which they are now made are red, blue, violet, green and amber. These colored lamps have been made only during the past few weeks, and they have been used only to a limited extent as yet. It is hardly necessary to say that with the colored lamps the number of combinations and effects that can be produced is greatly multiplied.

The handling of these small lamps is a branch of the electric lighting business which has not yet been taken hold of and developed by the illuminating companies. It is believed that when the lamps are better known, they will find a large demand.

Another lamp to which it is desired to call attention, is the lamp specially designed for use on power circuits where lamps are burned in series, and particularly for use on the 500 volt street railway circuit; in fact, the lamp is called the "electric railway lamp," and it is so labeled. When the electric railway business was first started it was intended, of course, to use incandescent lamps, but the question of the proper lamp to use was of small importance in comparison with others, and it was neglected in consequence. The lamp generally used on the Sprague roads when they first started was the regular 100 v., 16 c. p. lamp, the lamp of highest resistance and highest efficiency.

The importance of selecting lamps taking the same current, when they are to be burned in series, was not considered, and very often, I think I may say that on almost every road, lamps of different sizes and of different manufacturers have been placed in the same series, with results not always explained or accounted for, but apparently unfavorable, by comparison, to the lamp taking the least current under normal conditions.

If a lamp of higher candle-power, or if any lamp of equal voltage and taking a greater current is burned in series with a high efficiency 16 c. p. lamp, the result is that the 16 c. p. lamp receives the greater pressure; and, if the pressure is normal for burning two similar lamps in series, the above 16 c. p. lamp would be forced above normal candle-power and would soon be broken, if not broken immediately.

The Edison lamp has been the lamp of highest resistance on the market, and therefore it has been the one to suffer most for the above reason. As before stated, the Sprague roads have generally used these lamps at starting. No special lamp was made for the use of the railway companies, and no particular lamp has, in most cases, been recommended, consequently all lamps have been considered as being alike and suited for burning in series, particularly if they had the same marks for voltage. The natural result has been that dissimilar lamps have been placed in the same series, and the 16 c. p. Edison lamps have often given a very short life when, if they had been used alone, they would have given the best results. For the reason that the causes mentioned have not been understood, a large part of the lamp renewal business has been lost to the Lamp Works and to the Illuminating Companies.

The difficulty has been recognized by the Lamp Works, and we believe that it has been effectually provided against in the "electric railway lamp" which has but lately been put on the market. These "electric railway lamps" are designed particularly for the use of railways, but they are equally well suited for use on other power circuits, or in all other cases where lamps are burned in series on circuits of 200 to 500 or 600 volts. The lamps are made to give 18 c. p. The voltage ranges from 95 to 100 v.; and they take currents varying in different lamps from .60 to .75 ampere. The lamps have a special label, and the normal currents, the fractions of an ampere required to bring the lamps to 16 c. p., are marked on the labels.

The lamps are selected for voltages ranging from 95 to 100 v., but the voltage is not marked on the lamps; the marks for voltage have been found to produce confusion; customers, in some cases at least, have supposed that all lamps having the same marks for voltage were suited for burning in series as well as for burning in parallel circuit, whether the lamps were of the same resistance or not. For this reason the marks for the voltage of the lamps are omitted altogether.

As the regular 16 c. p. lamp has a very fine and delicate carbon, it was thought best, in designing the "railway" lamp, to give it a stouter carbon such as would not be so easily injured by the mechanical strain to which the carbon of the lamps are subjected. Also, very high efficiency is not to be desired in these lamps on account of the constant variation in the E. M. F. on the circuit. The efficiency of the lamp as determined on is about four watts per candle. Lamps of this efficiency will give the best results. The voltage on the circuit can fall considerably below the 500 v. limit, as it is constantly doing on the railway circuits, without bringing the lamps to a very low incandesence; also an increase in pressure of 10 per cent. will not cause the lamps to break at an abnormal rate.

Although the lamps in the regular stock will vary so as to take currents varying in different lamps from .60 to .75 ampere, it is not supposed that the lamps taking this whole range shall be sent to any one place. For any one plant the range of currents taken by the lamps will be limited to about 3–100 ampere, or all lamps sent to any one plant will be practically identical.

At the Lamp Works, and at other places where the "railway" lamps will be kept in stock, records of the amperage or the currents taken by the lamps sent to the different plants will be kept so that it will always be known just what lamps are wanted when lamps are called for by the railway company's renewal orders, and lamps of the same resistance will always be sent for use on the same circuits. Therefore it will be necessary to specify only the "electric railway lamp" when ordering lamps, and the proper lamps will be selected at the Lamp Works or at the other store houses where the lamps are kept.

Electric railways are being introduced very generally now, and such a large number of lamps are being consumed by them that it is well worth the while of those interested to look after the lamp renewals and see that the best lamp is used.

Where there are different roads in the same town, or where there are several different branches of the same system, it would be an advantage to have signal lamps of different colors on the different cars to distinguish those on one branch from those of another. Such colored lamps will be provided by the Lamp Works at small additional cost; we can now provide them of five different colors. When colored lamps are ordered by the railway companies, the lamps will be selected for the currents taken in the same way that the plain lamps are selected, so that all will be suited for burning in the same series.

On the street cars colored lamps can be placed on the front and rear platforms and in conspicuous positions to serve as signal lamps, while the remaining three lamps in the series are used to illuminate the interiors of the cars.

It may be added that the lamps will be made with bases other than the Edison bases, but, unless some other base or plug is specified, all lamps will be made to fit the regular Edison socket.

MEETING OF THE NEW YORK STATE STREET RAILWAY ASSOCIATION.

THE eighth annual meeting of the Street Railway Association of the State of New York, was held at the Powers Hotel, Rochester, N. Y., Tuesday, September 16th, 1890.

The following members were in attendance:—

ALBANY, N. Y.—Samuel Cowdry, Pres't Watervliet T. & Ry. Co.; John W. McNamara, Pres't Albany Railway.

BROOKLYN, N. Y.—E. W. Bliss, Director Brooklyn City Railroad Co.; Daniel F. Lewis, Pres't Brooklyn City Railroad Co.; John N. Partridge, Pres't Brooklyn City and Newtown Railroad Co.; William Richardson, Pres't Atlantic Avenue Railroad Co.; William J. Richardson, Sec'y Atlantic Avenue Railroad Co.

BUFFALO, N. Y.—Porter Norton, Director East Side Railway Co.; Henry M. Watson, Pres't Buffalo Street Railway Co.

NEW YORK CITY.—Charles P. Emmons, Sec'y Forty-second Street and Grand Street Ferry R. R. Co.; George Green, Pres't Forty-second Street and Grand Street Ferry R. R. Co.; Daniel B Hasbrouck, Sec'y Houston, West Street and Pavonia Ferry R. R. Co.; C. Densmore Wyman, V. P., Central Park N. & E. River R. R. Co.

PELHAM, N. Y.—W. R. Lambertson, Pres't Pelham Park Railroad Co.; Sherman T. Pell, Director Pelham Park Railroad Co.

ROCHESTER, N. Y.—John N. Beckley, Sec'y Rochester Railway Co.; Norman McD. Crawford, Asst. Mgr., Rochester Railway Co.; Arthur Luetchford, Treas., Rochester Railway Co.; Arthur G. Yates, Pres't Rochester Railway Co.

TROY, N. Y.—Charles Cleminshaw, Pres't Troy and Lansingburgh R. R. Co.; Charles H. Smith, Supt. Troy and Lansingburgh R. R. Co.

The meeting was called to order by President John N. Partridge, who in the course of his opening address spoke as follows:

Marked progress has been made since our last meeting in the

substitution of mechanical and electrical devices for the propulsion of street cars in the place of horses.

In many of our cities and towns where the electric car was unknown a year ago, it is to-day a familiar sight. Its coming has been opposed by a few alarmists, who predicted that it would bring with it death and destruction. Similar predictions were made of the locomotive, and even of the horse cars, in their early days. But public convenience was served by both, and their use has been marvelously extended. Wherever the electric car has been introduced, it seems to have met with general favor. Its noiselessness, its cleanliness, and its capacity for attaining a high speed wherever a high speed is safe, commend it to the riding public as a welcome substitute for the horse car, with the clatter of the hoofs and the slow jogs of the horses and their offensive droppings.

Some of the brightest minds in this and other countries are actively working to develop improvements in the various systems known as the "conduit," the "storage battery" and the "overhead wire." Who will dare to say what they will accomplish, in view of the great progress made during the last decade in the telephone and in electric lighting?

What we, as street railroad men, want, is a system which is simple and economical in its construction, in its adapation to our existing equipment and in its operation. The introduction of the electric car, with its greater weight, creates a demand for a heavier rail and a more substantially constructed road. Inventors are looking after our needs in this direction, and new patterns of rails and new methods of laying them are constantly brought to our notice.

THE REPORT OF THE EXECUTIVE COMMITTEE contained the following in relation to electricity:—

As the subject of the propulsion of street cars by electricity has become so prominent a question in the consideration of municipal authorities, as well as on the part of street railway managers, your Committee deemed it advisable to give unusual prominence at this meeting to the subject of electricity as a motive power. To this end, a report on the subject of "An Electric Street Railway Motor," prepared by the president of a company that is using a system of electric power, will be followed by the presentation of facts concerning electrical propulsion by the representatives of the several overhead systems, all of whom have been invited to attend the meeting for this purpose. It is confidently believed that the facts elicited will materially aid companies that for some time past have had the subject under consideration, in bringing about the desired change.

MR. JOHN W. MCNAMARA then read a paper entitled "Electric Street Railway Motors."[1]

The companies manufacturing electric railway apparatus having been invited to describe their various systems before the Convention were then called upon to address the members.

MR. FRANK A. ROGERS, representing the Short Electric Railway Co., described the system of the company, and laid stress upon the fact of the employment of very large pinions (6½ in. in diameter) made of the best machine steel. The large gears are made of cast-steel, and have wooden webs between the rim and the hub, which are put there for the purpose of deadening the noise, and also to serve as an insulation, insulating the motor itself from the ground; the ground connection being made directly from the motor to the car axle by flexible cable connectors. The axle part of the motor is insulated by heavy wooden beams, connecting the motor itself with the axle portion. This was done in order to deaden the noise and to get perfect insulation from the ground to the armature. The field-magnets employed on the motor are four in number, are "series" wound in one coil on each magnet, and the coils on the armature are entirely separate from each other. If one of the coils should happen to burn out, it does not touch any other coil on the armature and is very easily repaired.

In reply to an inquiry, Mr. Rogers said that the "series" system, while it operated satisfactorily on small roads having but few cars, as, for instance, at Huntington, W. Va., or Columbus, O., had been abandoned for the parallel system by his company. One of the chief reasons which dictated this change was the difficulty experienced in constructing large series generators which would regulate quickly enough.

Mr. Rogers also referred to the fact that in the Short system no solder is employed where there is a strain on the line. The connections are all mechanical and made by a special device.

MR. E. E. HIGGINS, representing the Edison General Electric Co., followed with a description of the Sprague system, in which he remarked that the cost of coal and water required to operate a car for one day was seventy-five cents, while to feed 11 horses, necessary for the same service, cost over two dollars. He dwelt upon the use of the commutated field for varying the power of the motor, by which the use of a rheostat was avoided, and which caused a saving in fuel and in engine capacity required.

Mr. Higgins also drew attention to the fact that Mr. Edison had lately been devoting his entire attention to some changes in the motor, mostly mechanical. The fields of the motor are now spread slightly so as to allow a little more wire on the field coils, and to vary somewhat the amount of metal in the machine. This makes a somewhat more powerful machine, and in some respects improves the design. The gears have been widened. But the most important advance which had recently been made in electrical railway work was the adoption of the new style of winding the armatures, in which each coil of wire was entirely separate from the next, and could be put together, and taken off, independently, without disturbing its neighbor. The new winding left no awkward protuberance at the end of the armature and made repairs a simple matter.

Mr. Higgins also mentioned the fact that, in order to avoid all shock on starting, the new cars on the system of his company would have a slow starting device. This is put in the very instant the car starts, but is cut out immediately, and is not in the circuit at any time during the operation of the car.

Referring to the safety of their overhead system, Mr. Higgins said that at every two or three thousand feet the trolley wire is divided into sections entirely distinct from one another. Each section is fed from the conductors on the side through fusible cut outs, which, when the current in that line exceeds a given amount, will melt and cut off the entire section of the trolley wire from the source of electricity. In case of accident or fire, a rope can be thrown over the line, and the instant it touches the ground it is dead. It can then be taken up and put out of the way.

MR. NORMAN MCCARTY, who represented the Thomson-Houston Electric Company, in describing their system, said that his company had long recognized the fact that electrical railway apparatus involved not so much an electric, as a mechanical, problem. They had aimed to get it as simple as possible, and used no commuted fields. They had made up their minds that it was a good deal better to spend a little more money for coal, and avoid wear and tear.

They used a trolley wire which had about four or five times the sectional area of the silicon bronze wire, consequently they get rid of feed wires along the sides of the street. There was more objection to the wires on the side of the street than through the centre. They feed their lines, but do not break the circuit, except on extended and complicated circuits. They used the trolley wire as a conductor, and only fed where it is necessary on account of special grades or excessive work.

MR. RICHARDSON called attention to the fact that the Boston *Daily Advertiser*, one of the most conservative papers in this country, had sent out a letter asking information from all cities, from Portland, Me., to Galveston, Tex., in which electric railways are operated, inquiring what systems they used, whether there had been any loss of life in connection with the wires, whether there was any objection to the overhead system on the part of the public, and what had been the effect on the street railway service of the particular locality. They published these answers, so far as they have received them, from 64 different places. All but four of them were favorable to electricity. Nashville, Tenn., was the only place where there was any loss of life reported. The answer from that city was rather amusing. There had been a wire broken in that city, causing the death of a horse, and a negro woman caught up the wire and threw it over, and it gave her a shock that was very amusing in its effects, but it did her no injury. It killed the horse, but did not hurt the woman, going to show that it is easier to kill a horse than it was to kill a human being. Another objection came from Newport, R. I., where the upper ten were objecting to anything which should popularize riding. The Mayor of Rochester responded favorably, as also did the Mayors of Troy, Buffalo and Albany.

MR. F. R. CHINNOCK, of the Edison Company, said that he had been connected with the Bell Telephone Company, of New York, the Bell Telephone Company, of Boston, and the New York and New Jersey Telephone Company. The telephone companies could do away with induction, if they would only go to expense. The method was well known. They should provide a return metallic circuit.

MR. CLEMINSHAW, of Troy, said they were threatened with injunction suits by the telephone companies. They kept them off until the accidental discovery was made in Albany of a method of overcoming this interference. They put down two supplemental wires, connected them, and ran them through to the station. The thing had worked very effectively, and was an inexpensive method of overcoming the trouble referred to.

Officers for the ensuing year were then elected as follows: President, Daniel F. Lewis, Brooklyn; first vice-president, John N. Beckley, Rochester; second vice-president, John S. Foster, New York; secretary and treasurer, William J. Richardson, New York; executive committee, John N. Partridge, Brooklyn; Charles Cleminshaw, Troy; C. Densmore Wyman, New York.

At one o'clock an adjournment was taken, after which the members had luncheon at the Rochester Club House. A trip to Charlotte over the electric road followed. In the evening the members were entertained at the Genesee Valley Club House. The entertainment of the members while in the city was conducted by Secretary Beckley, of the Rochester Railway Company.

The next meeting of the Association will be held at the Hotel Metropole, New York, the third Tuesday in September, 1891.

1. See page 334.

MEETING OF THE ASSOCIATION OF EDISON ILLUMINATING COMPANIES, AT MINNEAPOLIS.

THE session was opened by President John I. Beggs, at 11.30 A. M., Tuesday, September 16. The members present at the opening session were as follows:

Edison General Electric Company: —Samuel Insull, Second V. President; H. Ward Leonard, Gen. Mgr. Light and Power Department; John Muir, Gen. Mgr. Railway Department; Francis R. Upton, Gen. Mgr. Lamp Mfg. Department; F. E. Jackson, Inspector Lamp Mfg. Department; Wilson S. Howell, Inspector Lamp Mfg. Department; W. J. Jenks, Legal Department; M. J. Sullivan, Official Stenographer; L. Stieringer.

Illuminating Companies:—John I. Beggs, Director, Harrisburgh, E. L. Co., Harrisburgh, Pa.; G. H. Finn, Sec. & Treas. E. Co., St. Paul, Minn.; C. H. Maxcy, Sec. Edison L. & P. Co., Minneapolis, Minn.; Oscar Ericksson, Supt. The Cascade Milling Co., Sioux Falls S. Dak.; Edwin R. Weeks, Gen. Mgr. E. E. L. & P. Co. Kansas City, Mo.; Frederick Nicholl, Mgr. & Sec. Toronto Incandescent E. L. Co., Toronto, Canada; F. G. Kurz, Supt. Appleton E. L. Co., Appleton, Wis.; B. L. Smith, Asst. Sec. & Supt. Laramie E. Gas Light & Fuel Co. Laramie, Wyoming; Wm. D. Kurz, Supt. E. L. & P. Co., La Crosse, Wis.; Wm. L. Church, Supt. The Chicago Edison Co., Chicago, Ill.; John R. Markle, Director E. L. & Fuel Gas Co., Grand Rapids, Mich.; M. A. Seal, Sec. & Treas. Forest City E. L. & P. Co.; W. H. Van Sickel, Mgr. Edison Sault L. & P. Co., Sault Ste. Marie; W. F. Wollen, Supt. E. E. L. Co., York, Pa.; Leigh Carroll, Pres. E. E. L. Co., Birmingham Ala.; C. L. Edgar, Gen. Mgr. E. E. L. Co., of Boston, Mass.; J. A. Colby, Sec. & Mgr. Des Moines Edison Light Co.; W. S. Barstow, Asst. Supt. E. E. L. Co., Brooklyn, N. Y.; H. J. Smith, Gen. Oper. Supt. The E. E. L. Co., New York; Chr. Wuestenfeld, Mgr. Elgin City Railway Co., Elgin, Ills.; A. L. Smith, Pres. Appleton Edison L. Co., Appleton, Wis.; C. P. Gilbert, Sec. & Mgr. E. L. Co., Detroit, Mich.; Hoyt Post, Director and Attorney E. L. Co., Detroit, Mich. The choice of officers for the ensuing year resulted as follows:—President, John I. Beggs; V. President, C. L. Edgar; Secretary, W. J. Jenks; Treasurer, Wilson S. Howell; Executive Committee, John I. Beggs, ex-officio; A. L. Smith, Appleton, Wis.; Thos. P. Merritt, Reading, Pa.; E. R. Weeks, Kansas City, Mo.; C. P. Gilbert, Detroit, Mich.; Leigh Carroll, Birmingham, Ala.

In addition to the representatives of Edison interests, the following gentlemen were in attendance: Robert Coleman, Indurated Fibre Co., New York; Fred. W. Cushing, Central Electric Co., Chicago; B. L. Ames, Ames-Wright Co. (Western Electric Co. agents), St. Paul; John Roberts, *Street Railway Gazette*, Chicago; M. E. Baird, A. D. Newton, vice-president, Eddy Electric Motor Co., New York; Senator Washburn, of Minnesota; H. T. Greenfield, Interior Conduit and Ins. Co., New York; D. B. Dean, *Electrical Review*, Chicago; Fred. DeLand, *Electrical World*, Chicago; A. C. Durburow, J. B. O'Hara, *Western Electrician*, Chicago; E. L. Powers, *Electrical Industries*, Chicago; W. Forman Collins, ELECTRICAL ENGINEER, Chicago; Thos. R. Taltavall, *Electric Age*, New York; William Hubbard, Elgin Telephone Co., Elgin, Ill.; Foree Bain, Chicago; H. L. Lufkin, C. & C. Elec. Mot. Co., N.Y.

The following gentlemen represented Edison interests at the Exposition: E. W. Hammer, A. Theo. E. Wangeman, Edison Phonograph Co.

An interesting discussion arose upon the results of the burning of arc lamps on Edison circuits, during which it appeared that the trial of this method during the past few months has resulted very satisfactorily to the companies whose experience was quoted.

At the afternoon session, Mr. Insull, second vice-president of the Edison General Electric Co., made interesting and important explanations of the status of the patent suits now being pressed by the parent organization, and the recent consolidation of all the licensed manufactories with the General Company. By this statement it appears that the effort will be to furnish electric light and power apparatus of any variety of the most approved character and at low prices in competition with any other venturing to come in the market. It is also the purpose of the company to furnish an Edison motor, and thus by the keeping of a stock of armatures and other supplies at each of the district centres, render it more easy for the companies to secure more promptly anything of this kind than heretofore. Also that Mr. Edison, who was unavoidably detained at the laboratory, is, and will in the future be, actively engaged in perfecting the present and developing new apparatus in the field of electric light and power.

A discussion of the effects of crosses from high pressure circuits with Edison three-wire conductors developed great interest, and a report from Mr. Wilson S. Howell, who has for some months been gathering statistics, showed that in no case thus far noted, had a cross with a high pressure direct or alternating circuit proved damaging to the Edison wires or apparatus. A committee was appointed to further investigate this subject with special reference to the possible future interference of electric power systems, such as railways. The committee was appointed by the president, as follows:—C. P. Gilbert, Detroit; Wilson S. Howell, New Brunswick, N. J.; C. L. Edgar, Boston; H. Ward Leonard and J. H. Vail, N. Y.

The recent improvements in the Edison electric meter and the development of a new mechanical (registering) meter formed the subject of two papers, one by Mr. A. E. Kennelly,[1] of the Edison laboratory, and another by Mr. R. S. White,[2] of the Edison E. I. Co., of Brooklyn, N. Y.

A report by the secretary on the "Grounding of the Neutral Wire in Three-wire Systems" was read and assigned for discussion on Wednesday.

Special assignment of the questions of central station insurance and the proposed National Code of insurance rules for electric light and power work was also made to Wednesday at 10 a.m.

A paper on "Comparative Statistics on Electric Lighting in the United States" was read by Mr. F. R. Upton, of the lamp department of the Edison General Electric Company, and brought out an interesting discussion.

Adjournment was then made till Wednesday morning.

WEDNESDAY SESSION, SEPTEMBER 17TH.

The session was opened by the Report of the Special Committee on Insurance of Central Stations, after which Mr. S. E. Barton, president of the Electric Mutual Insurance Co., was introduced.

MR. BARTON, after explaining the plan of the Electric Mutual Company, stated that his company had already nearly $2,000,000 worth of insurance, $1,700,000 of which was written on electric stations, and $300,000 on first-class manufacturing property. He explained that the premiums charged were about five times what experience has ever shown losses and expenses to require and the company therefore returned the other four-fifths in the way of dividends, so that the chances for assessment were very remote. The premium charged for a station of the best construction, built of brick or stone, not over two stories high, and with electrical apparatus arranged in strict accordance with the requirements, was nine-tenths of one per cent.

MR. MARKLE, of Detroit, Chairman of the Committee on Fuel Gas, made a brief report as to the progress made since the Niagara Falls Convention in the experimental work of adapting this fuel to uses akin to that of electric light and power stations.

MR. F. E. JACKSON, of the Lamp Department of the Edison General Electric Company, presented a paper "On the Use of Miniature Incandescent Lamps in Decorative Work".[3]

MR. L. STIERINGER, the well known expert in the distribution of light, being called on to make some further explanations of the possibilities in the application of small lamps, gave an interesting and valuable talk upon the general subject, referring among other things to the effects produced on the Tower of Light at the Minneapolis Industrial Exposition.

MR. E. R. WEEKS, of Kansas City, introduced the subject of the "Heating of Buildings from Central Stations by Exhaust Steam," and a discussion which followed was participated in by Messrs. Edgar, Beggs, Markle and Vail.

As pertinent to the subject of insurance, the secretary read a paper "On the Formation of a Code of Insurance Rules,"[4] which it is proposed shall be adopted by the underwriters throughout the country.

MR. VAN SICKEL, of Sault Ste. Marie, inquired as to the proper construction of submarine cables for electric light and power works, and remarks were made by Messrs. Stieringer, Edgar, Beggs, Nichols, and the secretary was instructed to request Mr. Kennelly, of the Edison Laboratory, to prepare a paper on the subject to be incorporated in the minutes of this meeting.

The Association then adjourned, to meet on the Atlantic seaboard 12 months hence, the exact date and place to be designated by the executive committee.

AMERICAN ELECTRICAL UNITS.

THE first meeting of the American Institute of Electrical Engineers for the season 1890–91, was held at the handsome headquarters, 12 West Thirty-first street, this city, on September 16. Prof. Anthony, president, was in the chair. The committee on wiring tables presented their report, in which they came to the conclusion that, "Matthiessen's standard" is: "A hard drawn copper wire, one metre long, weighing one gramme, has a resistance of .1469 B. A. ohms, at 0° centigrade." The report was discussed and referred back to the committee for slight revision. Constants for converting the above to metre, millimetre and foot-mil dimensions, and to legal ohms at an assumed specific gravity, will be given.

The meeting then took up the proposition of Prof. F. B. Crocker that the unit of self-induction be hereafter known as the "henry," after Prof. Joseph Henry, instead of as the "quadrant," the term adopted at the last Electrical Congress in Paris. After a very interesting and animated discussion, the name was unanimously adopted amid applause. A committee was appointed to consider what would be the proper size of the unit, and to report at the next meeting. The unit will then be submitted for approval to the next International Electrical Congress, which will probably be that of 1892 in this city or Chicago.

A committee was appointed to co-operate with that of the National Electric Light Association on determining the true values and ratings of incandescent lamps.

1. See page 334. 2. See page 331. 3. See page 336. 4. See page 335.

ON ANTI-EFFECTIVE COPPER IN PARALLEL CONDUCTORS OR IN COILED CONDUCTORS FOR ALTERNATE CURRENTS.[1]

BY SIR WM. THOMSON.

It is known that by making the conductors of a circuit too thick, we do not get the advantage of the whole conductivity of the metal—copper, let us say—for alternate currents. When the conductor is too thick, we have in part of it comparatively ineffective copper present; but, so far as I know, it has generally been supposed that, the thicker the conductor, the greater will be its whole effective conductance, and that thickening it too much can never do worse than add comparatively ineffective copper to that

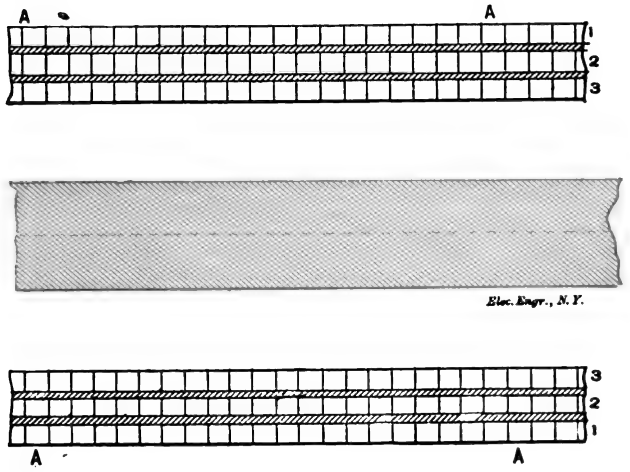


Fig. 1.

which is most effective in conveying the current. It might, however, be expected that we could get a positive augmentation of the effective ohmic resistance, because we know that the presence of copper in the neighborhood of a circuit carrying alternate currents, causes a virtual increase of the apparent ohmic resistance of the circuit, in virtue of the heat generated by the currents induced in it. May it not be that, anti-effective influence, such as is thus produced by copper not forming part of the circuit, can be produced by copper actually in the circuit if the conductor be too thick? Examining the question mathematically, I find that it must be answered in the affirmative, and that great augmentation of the effective ohmic resistance is actually produced if the conductor be too thick, especially in coils consisting of several layers of wire laid over one another in series around a cylindric or flat core (as in various forms of transformers).

Fig. 1 may be imagined to represent the secondary coil of a transformer, consisting of solid square copper wire in three layers. For simplicity, we suppose the axial length to be infinitely great, and straight; but the uniformity which this involves, and a close practical application to its simplicity is realized in that excellent form of transformer which consists of a toroidal iron core completely covered by primary and secondary wires laid on toroidal surfaces. To simplify the mathematical work, I suppose the whole thickness of the three layers to be small in comparison with the greatest radius of curvature of the circular or flat cylindric surface on which the wire is wound, but if it is not so the solution is easily obtained, for the case of circular cylinders, in terms of the Fourier-Bessel functions. It is of no consequence for our present question what there be inside of coil No. 3, and if we please we may imagine there to be nothing but air; the drawing, however, indicates an iron core and space which might be occupied by the primary coil, if a transformer is the subject; or our coil, A, A, A, A, may be the primary coil of a transformer with secondary coil and core inside it, and the alternate current maintained in it by an external electromotive agent acting in an arc between its ends outside. Our present results are applicable to all these varieties of cases indifferently, all that is essential being that the total quantity of current be given at each instant, and be uniform throughout the whole length of the coiled conductor.

The full mathematical work which I hope to communicate to the *Philosophical Magazine* for publication in an early number, includes an investigation of the self-induction of the coil, with, or without, anything in its interior (such as the core, or primary wire of a transformer), but at present, I merely give results so far as effective ohmic resistance, or generation of heat in the interior of the wire of the coil, A, A, A, A, itself is concerned; which, as said above, is independent of everything in the interior, and of the mode in which the alternating current is produced, provided only that the total amount of electricity crossing the section of the wire per unit of time be given at each instant.

I have found an expression for the intensity of the current at any point in the metal of any one of the layers of a coil of one, two, three, or more layers; and have deduced from it an expression for the quantity of heat generated per unit of time, at any instant, per unit breadth in any one of the layers. I need not at present quote the former expression; the latter is as follows, with q to denote the dynamical value of in time average of the heat generated, per unit of time at different instants of the period, per unit breadth and unit length in layer No. i from the outside of the coil, c, the time average of the square of the total current per unit breadth at the time of its maximum, and a the thickness of the layer.

$$q = \frac{2\pi}{\lambda} \rho \, \Theta \, c^2,$$

$$\text{where } \Theta = \frac{\varepsilon^{2\theta} + 2\sin 2\theta - \varepsilon^{-2\theta}}{\varepsilon^{2\theta} - 2\cos 2\theta + \varepsilon^{-2\theta}} + 2i(i-1)\frac{\varepsilon^{\theta} - 2\sin\theta - \varepsilon^{-\theta}}{\varepsilon^{\theta} + 2\cos\theta + \varepsilon^{-\theta}}$$

and $$\theta = \frac{2\pi a}{\lambda}.$$

The numerical results shown in the table have been calculated, and the accompanying graphic representation (Fig. 2), drawn for me by Mr. Magnus Maclean.

Table of Values of θ.

$\frac{16\,\theta}{\pi}$	$i = 1$	$i = 2$	$i = 3$	$i = 4$
1	5.113	5.118	5.127	5.141
2	2.553	2.592	2.669	2.786
4	1.316	1.634	2.270	3.224
6	.9854	1.997	4.019	7.053
8	.9173	2.993	7.143	13.37
10	.9452	4.062	10.30	19.65
12	.9822	4.899	12.73	24.48
14	1.000	5.276	13.83	26.66
16	1.002	5.362	14.08	27.16
∞	——	5.00	13.00	25.00

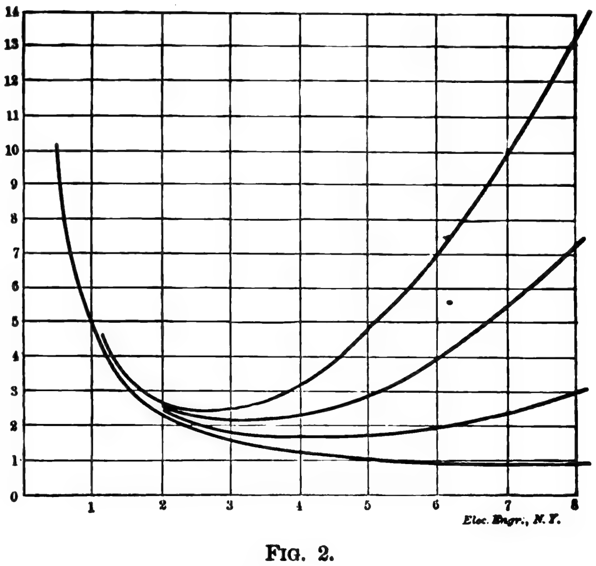


Fig. 2.

We see from the table and curves that each curve has a minimum distance from the line of abscissas, and that each comes to a horizontal asymptote, parallel to the line of abscissas, for $\theta = \infty$. By looking at the formula, we see that there is, in fact, an infinite succession of minimums and maximums in the expression for Θ, but it is only the first minimum, and the following maximum, that come within the range of variation of Θ, which we regard as sensible. In the case of $i = 1$, the formula gives $\theta = \frac{1}{2}\pi$ for the first minimum. The curves show for the case of $i = 2, 3, 4$, respectively, the first minimum at $\frac{16\,\theta}{\pi} = 4\frac{1}{2}$, 3, and 2.6, respectively. The thickness which corresponds to $\theta = \pi$ is the half wave length of the electric disturbance, which, is for copper 2.244 centimetres, when the frequency of the alternations

1. Abstract of a paper presented at the British Association Meeting, Leeds, September, 1890.

is 80 periods per second; and for this case, therefore, the thicknesses that give minimum generation of heat in the first, second, third, and fourth layers are, respectively, 11.22, 6.31, 4.21, and 3.65 millimetres. Anything more of continuous copper than these thicknesses in any of the layers would be not merely ineffective or comparatively ineffective, but would be positively anti-effective. Even with so small a thickness as 2.8 millimetres, for copper and frequency 80, line 2 of the table (corresponding to a sixteenth of the wave-length) shows, in the first, second, third, and fourth layers, losses of 0.3 per cent., 2 per cent., 5 per cent., and 10 per cent. in excess of that due to the true ohmic resistance of the copper, were it all effective. When the size chosen for the transformer and the amount of output required of it are such that a thickness of 2½ millimetres in the direction perpendicular to the layers is insufficient, a remedy is to be had by using braided wire, or twisted strand, with slight insulation of varnish or whitewash, crushed or rolled into rectangular or square form of the desired thickness and breadth. A very slight resistance between the different wires thus crushed together would suffice to cause the current to run nearly enough full bore to do away with any sensible loss from the cause which forms the subject of this communication.

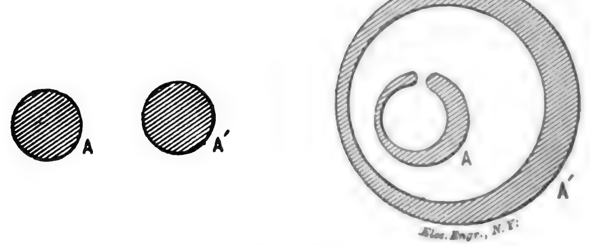
ON ALTERNATE CURRENTS IN PARALLEL CONDUCTORS OF HOMOGENEOUS OR HETEROGENEOUS SUBSTANCE.[1]

BY SIR WILLIAM THOMSON.

THIS paper consists of a description of some of the results of a full mathematical investigation of the subject which I hope to communicate to the *Philosophical Magazine* for an early number.

Two or more straight parallel conductors, supposed, for simplicity, to be infinitely long, have alternating currents maintained in them by an alternate current dynamo, or other electromotive agent applied to one set of their ends at so great a distance from the portion investigated, that in it the currents are not sensibly deviated from parallel straight lines. The other set of ends may, indifferently in respect to our present problem, be either all connected together without resistance, or through resistances, or through electromotive agents. All that we are concerned with at present is, that the conductors we consider form closed circuits, or one closed circuit; and that, therefore, the total quantities of electricity per unit of time at any instant traversing the normal sections in opposite directions are equal.

We suppose the period of the alternation to be very great in comparison with the time taken by light to traverse a distance equal to the greatest diameter of cross-section of our whole group of conductors. This supposition is implied in the previous assumptions of parallel rectilinearity of the electric stream-lines, and of equality of the quantities of electricity traversing, in opposite directions, the several areas of a normal section.



FIGS. 1 AND 2.

We further suppose that the length of our conductors and their effective ohmic resistances, are so moderate that the quantities of electricity deposited on, and removed from, their boundaries to supply the electrostatic forces along the conductors required for producing the alternations of the currents, are negligible in comparison with the total quantity flowing in either direction in the half-period. This supposition excludes important practical problems of telegraphy and telephony, the problem of long submarine cables, for instance, but it includes the problem of electric lighting by alternating currents transmitted at high tension through considerable distances, as, for example, from Deptford to London.

The general investigation includes as readily any number of separate circuits of parallel conductors, as a single circuit, but for simplicity in describing results, I suppose our system of conductors to be so joined at their ends as to constitute a single simple circuit of two parallel conductors. It may be either two conductors or one conductor, one of which may, or may not, surround the other, as shown in Figs. 1 and 2, representing cross-sections. Each conductor may be single, as in Figs. 1 and 2; or either may be multiple parallels.

We suppose each conductor to be homogeneous in substance and in cross-section from end to end, but not necessarily homogeneous in different parts of the cross-section. Thus, the different conductors, or the different parts of either, may be of different metals, or either conductor, or any part of either conductor, may consist of two metals (as iron and copper or iron and lead) laid parallel and soldered together.

We shall call A and A′ the cross sectional areas, or groups of areas of the two conductors, respectively, of the other. All the different portions of A are connected metallically at their two ends, and are thus all of them at one potential at one end and another potential at the other end, and similarly for A′. The homogeneousness of the material and of the cross-sections along the length of the conductors, and the uniformity of the total currents assumed above, implies that all the different parts of A in one cross sectional plane are at one potential, even though A consist of mutually isolated parts, or A′ consist of mere isolated parts. If, as in Figs. 1 and 2, all the parts of A are in mutual

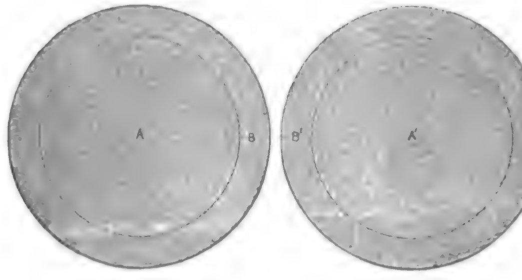


FIG. 3.

metallic connection, and all the parts of A′ are in mutual metallic connection, this would entail uniformity of potential through A, and uniformity of potential through A′, even without the limitation of our subject laid down above.

The following are among some of the most noteworthy results of the full mathematical treatment of the subject:—

I. When the period of alternation is large in comparison with 400 times the square of the greatest thickness or diameter of any of the conductors, multiplied by its magnetic permeability, and divided by its electric resistivity, the current intensity is distributed through each conductor inversely as the electric resistivity; the phase of alternation of the current is the same as the phase of the electromotive force; and the current across every infinitesimal area of the cross-section is calculated, according to the electromotive force at each instant, by simple application of Ohm's law.

II. When the period is very small in comparison with 400 times the square of the smallest thickness or diameter of any of the conductors, multiplied by its magnetic permeability, and divided by its electric resistivity, the current is confined to an exceedingly thin surface stratum of the conductors. The thickness of this stratum is directly as the square root of the quotient of resistivity, divided by the magnetic permeability of the substance in different parts of the surface, but the total quantity of the current per unit breadth of the surface is independent of the material, and, except in such cases as those referred to at the end of II. below, varies in each cross-section in simple proportion to the electric-surface density of the static electrification induced by the electromotive force applied between the extremities for maintaining the current. The distribution of this electric density is similar in all cross-sections, but its absolute magnitude at corresponding points of the cross-section varies along the length of the conductor in simple proportion to the difference of electric potentials between A and A′, and is zero at one end in the particular case in which the conductors are connected through zero resistance at one end while the electromotive force is applied by an alternate current dynamo at the other end. On the other hand, the surface-distribution of electric current is uniform throughout the whole length of the conductors, and it is only its distribution in different parts of the cross-section that varies as the electric density.

The proportionality of surface intensity of the current to electric density, asserted above, fails clearly in any case in which the circumstances are such that the distance we must travel along the surface to find a sensible difference in electric density is not very great in comparison with the thickness of the current-stratum. Such a case is represented in Fig. 3, which is reduced to scale, for alternate currents of period $\frac{1}{80}$th of a second in round rods of copper of 6 cms. diameter. The spaces between the outer circular boundaries and the inner fine circles, indicate what I have called the mhoic thickness being[1], .714 of a centimetre for copper of resistivity 1611 square centimetres per second. The full solution for such

1. Abstract of a paper presented at the British Assoc. Meeting, Leeds, 1890.

1. Collected Papers Vol. III., Art. CII., § 35.

a case as that represented in Fig. 3, belongs to the large class of cases intermediate between I. and II., and could only be arrived at by a kind of transcendent mathematics not hitherto worked. But without working it out, it is easy to see how the time-maximum intensity of the current will diminish inwards from the surface, and will be, at any point of either of the inner fine circles, about $\frac{1}{2}$ or $\frac{1}{3}$ of what it is at the nearest point of the boundary surface: and that at points in the surface, distant from B B′ by one-half, or one, or two times the mhoic thickness, the current intensity will be much smaller than it is at B B′.

III. In case I. the heat generated per unit of time, per unit of volume, in different parts of the conductors, is inversely as the electric resistivity of the substance, and directly as the square of the total strength of current at any instant. In case II. the time-average of the heat generated per unit of time, per unit of area of the current stratum, is as the time-average of the square of the quantity of current per unit breadth, multiplied by the square root of the product of the electric resistivity into the magnetic permeability.

Examples of cases I. and II.:—Let A consist of three circular wires, C, L and I, of copper, lead, and iron, respectively. In case I., the quantities of the whole current they will carry, and the quantities of heat generated per unit of time in them, will be inversely as their resistivities. In case II. if the centres of the three circular cross-sections form an equilateral triangle, the quantities of heat generated in them will be directly as the square roots of the resistivities for C and L; and for I would be as the square root of the product of the resistivity into the magnetic permeability, if the magnetic permeability were constant and the viscous or frictional resistance to change of magnetism nothing for the iron in the actual circumstances. This last supposition is probably true, approximately, with a permeability of $\frac{1}{80}$th for iron or steel, according to Lord Rayleigh, if the current is so small that the greatest magnetizing force acting on the iron is less than 0.1 C. G. S.

The dependence of the total quantity carried, on extent of surface, and on the solution of the electrostatic problem described in II, justifies Snow Harris, and proves that those who condemned him out of Ohm's law were wrong, in respect to his advising tubes or broad plates for lightning conductors, but does not justify him in bringing them down in the interior of a ship (even through the powder magazine), instead of across the deck and down its sides, or from the masts along the rigging and down the sides to the water. The non-dependence of the total quantities of current on the material, whether iron or non-magnetic metals, seems quite in accordance with Dr. Oliver Lodge's experiments and doctrine regarding "Alternative Path" and lightning conductors.

TELEPHONING THROUGH SUBMARINE CABLES.[1]

BY W. H. PREECE, F. R. S.

At the Newcastle meeting last year I gave the reasons and experiments which led to the conclusion that telephoning between London and Paris was practical. New and distinct overground lines of four copper wires are now being erected by the respective governments from each capital to the coast, and a new cable, the joint property of the two governments, will be laid during this year, between the Kent coast and San Gatte, to connect these two lines. There will thus be two metallic circuits between the two capitals. The K R, that is, the product of the capacity, K, and the resistance, R, of each circuit, upon which the clearness of articulation depends, will be 5,900, indicating that speech should be excellent.

A somewhat similar circuit has been established, since October last, between Buenos Ayres and Monte Video, under my advice. The cables across the La Plata are each 28 miles long, for there are two separate single wire cables, and the total distance between the two cities is 180 miles. Subscribers who have metallic circuits in each city have no difficulty whatever in speaking to each other from their respective offices, although the K R is as high as 10,400.

The cable across the channel will be a four-wire cable, and the specification for its construction has been based on the following mathematical considerations by Mr. H. R. Kempe.

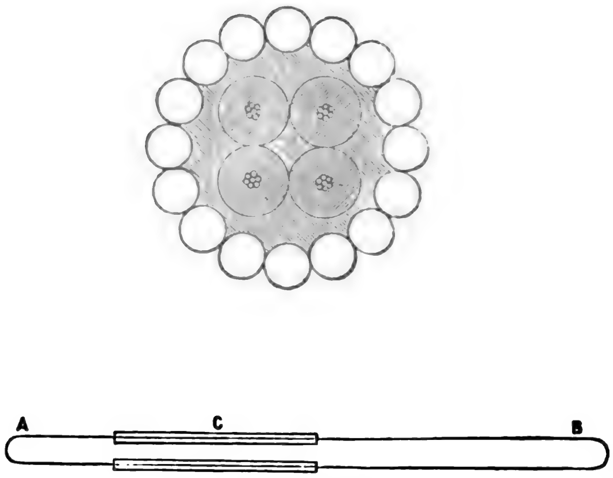
Let there be a looped telephonic line between A and B, Fig. 1, with a cable C, at an intermediate point on the route.

The working capacity of the whole line is dependent upon the product of the total resistance, R, and the total capacity, K. Therefore, if we take the resistance of the aerial portion of the line to be a fixed quantity, there will be a particular size of cable conductor which will give the smallest possible size of dielectric sufficient to enable a particular value of K R not to be exceeded. For, if we make the conductor larger than this size, and thereby diminish its resistance, we can, it is true, do with an increased capacity, but the diminution in the thickness of the dielectric which could thereby be allowed, is more than compensated for by the fact that the surface of the conductor is larger; in other words, we increase the capacity in a greater proportion than we diminish the resistance. If, on the other hand, we diminish the size of the conductor, we increase the resistance in a greater proportion than we diminish the capacity. Strictly speaking, the requirements of the problem are to determine the size of cable core which shall *cost least*; but, inasmuch as the costs of gutta-percha and copper, *bulk for bulk*, do not differ greatly, the problem resolves itself into the determination of the smallest outer diameter which can be employed.

The values obtained correspond very closely to a core, the weight of whose conductor is 160 lbs., and the weight of whose gutta-percha covering is 300 lbs., and it has, therefore, been decided to adopt those dimensions.

Although the calculation has been made on the assumption that the land lines on both sides of the cable are to be of 400 lbs. wire, the French government have decided that the wires to be erected by them shall be of 600 lbs. weight; the result of this will be to reduce the value of K R to 5,900, as stated at the commencement of the paper.

The specification of the cable states that: (1) Each conductor shall be formed of a strand of seven copper wires, all of equal diameter, shall weigh 160 lbs. per nautical mile, and shall at a temperature of 75° Fahrenheit have a resistance not higher than 7.632 ohms or lower than 7.478 ohms per nautical mile.



FIGS. 1 AND 2.

(2) Each conductor shall be insulated by being covered with three alternate layers of Chatterton's compound and gutta-percha, beginning with a layer of the said compound, and no more compound shall be used than may be necessary to secure adhesion between the conductor and the layers of gutta-percha. The dielectric on each conductor shall weigh 300 lbs. per nautical mile, making the total weight of each conductor when covered with the dielectric 460 pounds per nautical mile.

(3) The inductive capacity of such insulated conductor shall not exceed .3045 microfarad per nautical mile.

(4) The insulation resistance of each coil of core shall be not less than 500 megohms per nautical mile after such coil shall have been kept in water maintained at a temperature of 75° Fahrenheit for not less than 24 consecutive hours immediately preceding the test, and after electrification during one minute.

The cores (four in number) are to be served with the best wet fully tarred yarn, and with a sheathing of 16—280 mil. wires, each having a minimum breaking strain of 8,500 lbs., and a minimum of 10 twists in 6 inches. The section of the cable is shown in the accompanying engraving, Fig. 2.

1. Abstract of a paper read at the British Association meeting, Leeds, 1890.

THE WESTERN UNION ANNEX BUILDING.

Plans for a fourteen-story building to be built at 8 Dey street, this city, adjoining the Western Union Building, have been filed with the Building Bureau. The structure will be 25 by 67 feet and will cost $100,000. The architect is H. J. Hardenburgh and the builder, James B. Smith.

WORK OF THE YOUNG MEN'S INSTITUTE.

The Young Men's Institute of the Young Men's Christian Association, at 222 Bowery, will this year have classes in arithmetic, free-hand and mechanical drawing, carriage drafting, steam engineering, grammar and composition, vocal music, physiology, and first aid to the injured. The cost of membership is extremely moderate.

SECONDARY CELLS.[1]

BY W. J. S. BARBER STARKEY.

I SHALL only try to give a few of my personal experiences with secondary cells without attempting to go into their theory or construction, and I do this more in the hope that it may lead to some interesting discussion than for any value which may be attached to my experiences. Soon after the introduction of M. Faure's cells into this country I was fortunate enough to become possessed of one, which for a time gave excellent results, but it so happened I had to go away from home for six months, and on my return I found the cell would no longer work satisfactorily, and had become very inefficient.

To find out the cause of this I removed the plates from their felt envelopes, and found that they were partially covered with a white hard sulphate of lead, which I was unable to again reduce; I also found that it had eaten into the supporting plates, and that there was a thin film of white sulphate between these plates and the active material, which practically acted as a non-conductor. This seemed to me such a serious defect that I determined, if possible, to find out a remedy, and, after numberless ineffectual attempts, I at last found out that if a small quantity of carbonate of soda was added to the dilute acid, it not only allowed the existing sulphate to be again reduced, but it also prevented the formation in future of the hard white intractable sulphate, even if the cells were allowed to stand idle for any length of time. I have allowed plates to remain idle in this solution for more than 18 months, without the slightest trace of white sulphate appearing. I was so much impressed with the use of carbonate of soda to prevent sulphating of the plates that I brought the matter before Mr. Preece, and he very kindly came to look at the cells, and afterwards carried out a most careful series of experiments to determine the value, or otherwise, of using sulphate of soda in secondary cells. The results of these experiments are, I believe, well known, and have been published, and the exact amount of carbonate of soda which it is desirable to use has been determined; it is only necessary to use a very small quantity to effect the desired purpose. If much is used it is of no advantage, and may tend to cause scaling of the plates. Now that it is no longer necessary to pass a heavy current through cells, to prevent sulphating, it appears to me that it would be much more satisfactory to use larger cells for stationary work, and both charge and discharge them at a considerably lower rate than at present recommended, thereby enormously increasing the life and efficiency of the cells, and leaving a large surplus of energy in case of emergency. My own cells have been treated in this way, and I cannot see that they have in any way deteriorated after nearly five years' use. If the plates are kept free from sulphate they may be bent to a considerable extent without suffering any damage, and if the grids are made of pure soft lead they may be readily straightened again. Certainly my experience leads me to recommend the use of soft lead grids in preference to those of a hard and brittle alloy. I consider that burning the lugs together is the most satisfactory way of connecting up the cells, but if brass screws and nuts are used they can be greatly protected by pressing some lead foil over and around them; this will keep off any acid spray which might reach them while the cells are being charged, and should any of the brass connections become corroded, I have found that they can be effectually cleaned without trouble by immersing them for a time in a solution of carbonate of soda, and then washing them thoroughly in pure water. If it is desired to use separators between the plates, a very simple and cheap way to make them is to use perforated porous paper which has been saturated in melted paraffin wax; this stands well in dilute acid, and I have some which have been in use for several years.

Although secondary batteries are now undoubtedly very efficient when carefully used for stationary purposes, it appears to me that as at present constructed they will not stand for any long period the wear and tear, shaking and washing of the liquid against the active material to which they must be subjected when used for traction purposes; at least such is the impression left on my mind after inspecting cells which have been used for even a short time; some of the plates generally soon show signs of buckling, and the bottoms of the cells became covered with disintegrated particles of the active material, which forms a sort of mud. I have endeavored to overcome these defects by packing the plates in a solid, though porous, mass of plaster of Paris mixed with sawdust, and for three months a battery of 96 cells thus prepared was successfully running a tramcar at Canning Town and doing the same work as the other cars; however, at the end of this time the management passed into other hands, and I hear that the cells have been taken to pieces, as they were not giving satisfaction; so for the present this experiment has come to an end, and is apparently a failure, but I have not given up hopes that some modification of this plan may be successful, as for a time the working was very satisfactory. The proportion of plaster of Paris used in this experiment was two of plaster of Paris to one of sawdust, but I think the plaster of Paris was not pure, and its proportion was too great. I am now using a set of 22 Elwell-Parker cells, in which the proportion is 2½ of sawdust to 1 of plaster of Paris. The way I prepare the cells is to mix the plaster of Paris and sawdust intimately together in a dry state, and fill in the spaces between the plates with this mixture. I then pour in gently some dilute sulphuric acid to which a little carbonate of soda has been added, when the whole sets into a compact porous mass. After a time I pour in the electrolyte till it stands above the level of the tops of the plates, and it will be found that the cells will contain nearly as much liquid as if no porous material were used.

Last autumn I used a set of these cells in conjunction with a turbine and dynamo, and although they were last charged in November, I found on my return this year in June that they still retain the charge well after seven months' rest, and burnt the lamps brightly, the E. M. F. of each cell being just under 2 volts. Although in my experiments I have used plaster of Paris to insulate the particles of sawdust from each other, and to give stability of the porous mass, I have tried many other substances, both soluble and insoluble, mixed with it, but sawdust appears to act as well as anything which I have yet tried, and it has the advantage of being cheap, and can be easily procurable. This method of treating the cells would appear to be of no advantage in stationary work for electric lighting purposes, and would, indeed, be a distinct disadvantage, as, owing to the want of free circulation of the liquid, the E. M. F. falls more rapidly under a long-continued heavy discharge, but it immediately recovers with a short interval of rest, and, in practice, these intervals are constantly occurring in electric traction, when the car stops to take up and set down passengers; and with cells treated in this way the vibration and shaking of the car is a positive advantage, as it facilitates the circulation of the electrolyte, and tends to liberate any occluded gases. The defect of this arrangement would appear to be that it must hinder the free circulation of the liquid, and also add to the internal resistance of the cell, whilst, on the other hand, it prevents the plates from buckling, retains the active material firmly in its place, preserves the plates from injury, and makes the cell very portable. I have ventured to mention this crude experiment in the hope that it may induce some one to produce a thoroughly practical cell for traction purposes which will stand rough usage—be free from the defects which at present exist.

1. Abstract of a paper read before the British Association Meeting, Leeds, September, 1890.

RENTALS IN THE NEW YORK SUBWAYS.

The meeting of the Board of Electrical Control, on September 19, was devoted to a long discussion of subway rentals. Engineer Kearney reported on the subject. The report gives the present schedule of rentals charged by the subway company as follows: For 4-inch ducts, $1,250 per mile per annum. For 3-inch ducts, $1,000 per mile per annum. For 2½-inch ducts, $850 per mile per annum. For 2-inch ducts, $700 per mile per annum. For 1½-inch ducts, $550 per mile per annum. For 1¼-inch ducts, $500 per mile per annum. For distribution ducts, 1 to 4 inches, $1,000 per annum.

The telegraph and telephone companies have made no complaint in reference to the rentals. The high-tension electric light companies have appealed from the schedule. They generally occupy ducts of three inches diameter, and are charged rentals of $1,000 per mile per annum.

The subway company filed a statement with Mr. Kearney, showing that up to Jan. 1, 1890, 501 miles of telegraph and telephone ducts and 515 miles of electric light and power ducts had been constructed, making a total of 1,016 miles of ducts, the cost of maintaining and constructing which was $4,827,647.97 from 1886 to 1890. Only 404 miles of subways was occupied, producing at present rates an annual rental of $388,771. The yearly expenses of the subway company are placed at $826,382, and an annual deficit of $437,611 is figured out.

Some of the local companies want an investigation of the subway company's books, but Mr. Lauterbach claims that as the company is not making 10 per cent, such investigation is not in order. It is now proposed that pending a settlement of the question, the companies shall pay $500 per mile of duct.

THE NEW OHM.

At the recent meeting of the British Association it was recommended that the ohm be defined by the resistance of a mercury column of one square millimetre section, 106.3 centimetres long and at 0° C. Profs. Rowland and Barker undertook to refer this recommendation to the United States Government, while M. Mascart and Mr. Preece, respectively, will present it to the French and English authorities.

THE SMITHSONIAN INSTITUTION has been benefited by two donations to its funds. One is a legacy of $5,000, and the other a personal gift of $5,000 from Prof. A. Graham Bell to the Superintendent. The latter gentleman has handed over the sum to the Institution.

CORRESPONDENCE.

PITTSBURGH.

An Electric Process for Making "Wrought" Iron—Regulating the Wires.

A PROCESS of making wrought iron from pig metal without puddling is one of the discoveries made by Dr. Emmens, of Greensburg, near this city. The doctor accomplishes his object with the aid of electricity. He takes a vat which is filled with a chemical solution and a number of thin sheet iron plates. Then, the pig iron is also placed in the vat, after which the pig iron and the sheet iron are connected with a dynamo. The current generated by the dynamo is said to have the effect of causing the pure iron to be separated from the impurities in the pig iron and form a deposit on the sheet iron plates.

The quality of this wrought iron is stated to be superior to that of the best Swedish metal. It can be bent, rolled or twisted into any shape, while cold. Dr. Emmens says that he can take a horse shoe nail of this iron, fasten the head in a vice and twist it into an almost perfect screw without breaking.

An ordinance providing for the regulation of electric wires in the streets will be acted upon by councils within the next few days. All the electric wires must be placed at least twenty feet above the side walks, and where there are street railway wires on the same street, the former wires must be a sufficient distance above the others so as not to interfere. Underground wires, cables, tubes, conduits and subways shall be placed at least two feet under the ground and as near the street curb as practicable.

PITTSBURGH, Sept. 18, 1890.

ST. LOUIS.

Electric Railway News.—Resignations and Appointments.—The Turner Unicycle Road.

DURING the summer months the work of changing the motive power on the Lindell Railway has progressed steadily, but with some delay at times on account of scarcity of material of all kinds. The policy of the company is to construct a first-class electric railway regardless of cost and time. The new power house is finished and the machinery is being placed in position. Six boilers are set and ready for steam. Eight dynamos are on hand and being set up, and the first of the four 400 h. p. Armington & Sims engines is expected to arrive about the 20th.

The Vandeventer Avenue Street Railway will be operated as a part of the Lindell Railway. The construction of this road is being pushed to completion with the same thoroughness as the main line of the Lindell, the intention being to have it in operation by October 1 so as to accommodate visitors to the St. Louis Agricultural Fair. The Vandeventer avenue line will extend from Chouteau avenue to the fair grounds, and will thus form a direct line from Union Depot to the fair grounds. The acquisition of the Vandeventer line gives the Lindell Railway Company a total of 18 miles of double track.

Mr. E. J. Bagnall has resigned his position as superintendent of the St. Louis Illuminating Company and has accepted the position of engineer of the Lindell Railway Company, and will have complete charge of everything pertaining to mechanical and electrical engineering.

The St. Louis Unicycle Railway Company has been incorporated under the laws of the State of Missouri, with a capital stock of $200,000, with the following officers: President, L. A. Brown; vice-presidents, John H. French and J. W. Tremayne; treasurer, W. A. Adams; secretary, Chas. H. Wengler; directors, Chas. H. Gleason, Chas. H. Blake and David Strawbridge. The Unicycle railway is the invention of E. M. Turner, of Texas, and is an elevated electric railway having only one rail. A motor car propelled by a one h. p. Sprague electric motor is now in operation at the exposition.

The McKee street railway syndicate have closed a contract with the Short Electric Railway Company for 1,000 motors. This syndicate has been formed lately for the purpose of purchasing, constructing and operating electric railways, and this order is given so as to have the motors ready for use as fast as they may be required.

Mr. C. L. Abbott has resigned his position as superintendent of the Short Electric Railway, on the south end of the St. Louis railroad, and has accepted the position of superintendent of the Glenwood and Greenlawn Street Railway, Sprague system, Columbus, O., and will leave shortly for his new field of labor.

The Board of Public Improvements have appointed Andrew J. O'Reilly supervisor of city lighting in place of E. V. Matlack. No specific charges were brought against Mr. Matlack by the board, the change being made merely to quiet a general dissatisfaction which has existed since Mr. Matlack's appointment over a year ago, he at that time not being legally a citizen of St. Louis.

ST. LOUIS, September 15, 1890.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.
Anonymous communications cannot be noticed.
The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.
In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.
Sketches and drawings for illustrations should be on separate pieces of paper.
All communications should be addressed EDITOR OF THE ELECTRICAL ENGINEER, *150 Broadway, New York city.*

TESLA'S NEW ALTERNATING MOTORS.

[189.]—I hope you will allow me the privilege to say in the columns of your esteemed journal a few words in regard to an article which appeared in *Industries* of August 22, to which my attention has been called. In this article an attempt is made to criticise some of my inventions, notably those which you have described in your issue of August 6, 1890.

The writer begins by stating: "The motor depends on a shifting of the poles under certain conditions, a principle which has been *already*[1] employed by Mr. A. Wright in his alternating current meter." This is no surprise to me. It would rather have surprised me to learn that Mr. Wright has *not yet* employed the principle in his meter, considering what, before its appearance, was known of my work on motors, and more particularly of that of Schallenberger on meters. It has cost me years of thought to arrive at certain results, by many believed to be unattainable, for which there are now numerous claimants, and the number of these is rapidly increasing, like that of the colonels in the South after the war.

The writer then good-naturedly explains the theory of action of the motive device in Wright's meter, which has greatly benefited me, for it is so long since I have arrived at this, and similar theories, that I had almost forgotten it. He then says: "Mr. Tesla has worked out some more or less complicated motors on this principle, but the curious point is that he has completely misunderstood the theory of the phenomena, and has got hold of the old fallacy of screening." This may be *curious*, but how much *more curious* it is to find that the writer in *Industries* has *completely misunderstood* everything himself. I like nothing better than just criticism of my work, even if it be severe, but when the critic assumes a certain "l'état c'est moi" air of unquestioned competency I want him to know what he is writing about. How little the writer in *Industries* seems to know about the matter is painfully apparent when he connects the phenomenon in Wright's meter with the subject he has under consideration. His further remark, "He (Mr. Tesla) winds his secondary of iron instead of copper and thinks the effect is produced magnetically," is illustrative of the care with which he has perused the description of the devices contained in the issue of THE ELECTRICAL ENGINEER above referred to.

I take a motor having, say eight poles, and wrap the exciting coils of four alternate cores with fine insulated iron wire. When the current is started in these coils it encounters the effect of the closed magnetic circuit and is retarded. The magnetic lines set up at the start close to the iron wire around the coils and no free poles appear at first at the ends of the four cores. As the current rises in the coils more lines are set up, which crowd more and more in the fine iron wire until finally the same becomes saturated, or nearly so, when the shielding action of the iron wire ceases and free poles appear at the ends of the four protected cores. The effect of the iron wire, as will be seen, is two-fold. First, it retards the energizing current; and second, it delays the appearance of the free poles. To produce a still greater difference of phase in the magnetization of the protected and unprotected cores, I connect the iron wire surrounding the coils of the former in series with the coils of the latter, in which case, of course, the iron wire is preferably wound or connected differentially, after the fashion of the resistance coils in a bridge, so as to have no appreciable self-induction. In other cases I obtain the desired retardation in the appearance of the free poles on one set of cores by a magnetic shunt, which produces a greater retardation of the current and takes up at the start a certain number of the lines set up, but becomes saturated when the current in the exciting coils reaches a predetermined strength.

In the transformer the same principle of shielding is utilized. A primary conductor is surrounded with a fine layer of laminated iron, consisting of fine iron wire or plates properly insulated and interrupted. As long as the current in the primary conductor is so small that the iron enclosure can carry all the lines of force set up by the current, there is very little action exerted upon a secondary conductor placed in vicinity to the first; but just as soon as the iron enclosure becomes saturated, or nearly so, it loses the virtue of protecting the secondary and the inducing action of the primary practically begins. What, may I ask, has all this to do with the "old fallacy of screening?"

With certain objects in view—the enumeration of which would

1. All italics are mine.—N. T.

lead me too far—an arrangement was shown in THE ELECTRICAL ENGINEER, about which the writer in *Industries* says: "A ring of laminated iron is wound with a secondary. It is then encased in iron laminated in the *wrong direction* and the primary is wound outside of this. The layer of iron between the primary and secondary is supposed to screen the coil. Of course it cannot do so, such a thing is unthinkable." This reminds me of the man who had committed some offense and engaged the services of an attorney. "They cannot commit you to prison for that," said the attorney. Finally the man *was* imprisoned. He sent for the attorney. "Sir," said the latter, "I tell you they *cannot* imprison you for that." "But, sir," retorted the prisoner, "they *have* imprisoned me." It *may not* screen, in the opinion of the writer in *Industries*, but just the same it *does*. According to the arrangement the *principal* effect of the screen may be either a retardation of the action of the primary current upon the secondary circuit or a deformation of the secondary current wave with similar results for the purposes intended. In the arrangement referred to by the writer in *Industries* he seems to be certain that the iron layer acts like a choking coil; there again he is mistaken; it does not act like a choking coil, for then its capacity for maintaining constant current would be very limited. But it acts more like a magnetic shunt in constant current transformers and dynamos, as, in my opinion, it ought to act.

There are a good many more things to be said about the remarks contained in *Industries*. In regard to the magnetic time lag the writer says: "If a bar of iron has a coil at one end, and if the core is perfectly laminated, on starting a current in the coil the induction *all along the iron* corresponds to the excitation at that instant, unless there is a microscopic time lag, *of which there is no evidence*." Yet a motor was described, the very operation of which is dependent on the time lag of magnetization of the different parts of a core. It is true the writer uses the term "perfectly laminated" (which, by the way, I would like him to explain), but if he intends to make such a "perfectly laminated" core I venture to say there is trouble in store for him. From his remarks I see that the writer completely overlooks the importance of the size of the core and of the number of the alternations pointed out; he fails to see the stress laid on the saturation of the screen, or shunt, in some of the cases described; he does not seem to recognize the fact that in the cases considered the formation of current is reduced as far as practicable in the screen, and that the same, therefore, so far as its quality of screening is concerned, has no role to perform as *a conductor*. I also see that he would want considerable information about the time lag in the magnetization of the different parts of a core, and an explanation why, in the transformer he refers to, the screen is laminated in the *wrong direction*, etc.—but the elucidation of all these points would require more time than I am able to devote to the subject. It is distressing to find all this in the columns of a leading technical journal.

In conclusion, the writer shows his true colors by making the following withering remarks: "It is questionable whether the Tesla motor will ever be a success. Such motors will go round, of course, and will give outputs, but their efficiency is doubtful; and if they need three-wire circuits and special generators there is no object in using them, as a direct current motor can be run instead with advantage."

No man of broad views will feel certain of the success of any invention, however good and original, in this period of feverish activity, when every day may bring new and unforseen developments. At the pace we are progressing the permanence of all our apparatus it its present forms becomes more and more problematical. It is impossible to foretell what type of motor will crystalize out of the united efforts of many able men; but it is my conviction that at no distant time a motor having commutator and brushes will be looked upon as an antiquated piece of mechanism. Just how much the last quoted remarks of the writer of *Industries*—considering the present state of the art—are justified, I will endeavor to show in a few lines.

First, take the transmission of power in isolated places. A case frequently occurring in practice and attracting more and more the attention of engineers is the transmission of large powers at considerable distances. In such a case the power is very likely to be cheap, and the cardinal requirements are then the reduction of the cost of the leads, cheapness of construction and maintenance of machinery and constant speed of the motors. Suppose a loss of only 25 per cent. in the leads, at full load, be allowed. If a direct current motor be used, there will be, besides other difficulties, considerable variation in the speed of the motor—even if the current is supplied from a series dynamo—so much so that the motor may not be well adapted for many purposes, for instance, in cases where direct current transformation is contemplated with the object of running lights or other devices at constant potential. It is true that the condition may be bettered by employing proper regulating devices, but these will only further complicate the already complex system, and in all probability fail to secure such perfection as will be desired. In using an ordinary single-circuit alternate current motor the disadvantage is that the motor has no starting torque and that, for equal weight, its output and efficiency are more or less below that of a direct current motor. If, on the contrary, the armature of any alternator or direct current machine—large, low-speed, two-pole machines will give the best results—is wound with two circuits, a motor is at once obtained which possesses sufficient torque to start under considerable load; it runs in absolute synchronism with the generator—an advantage much desired and hardly ever to be attained with regulating devices; it takes current in proportion to the load, and its plant efficiency within a few per cent. is equal to that of a direct current motor of the same size. It will be able, however, to perform more work than a direct current motor of the same size, first, because there will be no change of speed, even if the load be doubled or tripled, within the limits of available generator power; and, second, because it can be run at a higher electromotive force, the commutator and the complication and difficulties it involves in the construction and operation of the generators and motors being eliminated from the system. Such a system will, of course, require three leads, but since the plant efficiency is practically equal to that of the direct current system, it will require the same amount of copper which would be required in the latter system, and the disadvantage of the third lead will be comparatively small, if any, for three leads of smaller size may perhaps be more convenient to place than two larger leads. When more machines have to be used there may be no disadvantage whatever connected with the third wire; however, since the simplicity of the generators and motors allows the use of higher electromotive forces, the cost of the leads may be reduced below the figure practicable with the direct current system.

Considering all the practical advantages offered by such an alternating system, I am of an opinion quite contrary to that of the author of the article in *Industries*, and think that it can quite successfully stand the competition of any direct current system, and this the more, the larger the machines built and the greater the distances.

Another case frequently occurring in practice is the transmission of small powers in numerous isolated places, such as mines, etc. In many of these cases simplicity and reliability of the apparatus are the principal objects. I believe that in many places of this kind my motor has so far proved a perfect success. In such cases a type of motor is used possessing great starting torque, requiring for its operation only alternating current and having no sliding contacts whatever on the armature, this advantage over other types of motors being highly valued in such places. The plant efficiency of this form of motor is, in the present state of perfection, inferior to that of the former form, but I am confident that improvements will be made in that direction. Besides, plant efficiency is in these cases of secondary importance, and in cases of transmission at considerable distances, it is no drawback, since the electromotive force may be raised as high as practicable on converters. I can not lay enough stress on this advantageous feature of my motors, and should think that it ought to be fully appreciated by engineers, for to high electromotive forces we are surely coming, and if they must be used, then the fittest apparatus will be employed. I believe that in the transmission of power with such commutatorless machines, 10,000 volts, and even more, may be used, and I would be glad to see Mr. Ferranti's enterprise succeed. His work is in the right direction, and, in my opinion, it will be of great value for the advancement of the art.

As regards the supply of power from large central stations in cities or centres of manufacture, the above arguments are applicable, and I see no reason why the three-wire motor system should not be successful. In putting up such a station, the third wire would be but a very slight drawback, and the system possesses enough advantages to over-balance this and any other disadvantage. But this question will be settled in the future, for as yet comparatively little has been done in that direction, even with the direct current system. The plant efficiency of such a three-wire system would be increased by using, in connection with the ordinary type of my motor, other types which act more like inert resistances. The plant efficiency of the whole system would, in all cases, be greater than that of each individual motor—if like motors are used—owing to the fact that they would possess different self-induction, according to the load.

The supply of power from lighting mains is, I believe, in the opinion of most engineers, limited to comparatively small powers, for obvious reasons. As the present systems are built on the two-wire plan, an efficient two-wire motor without commutator is required for this purpose, and also for traction purposes. A large number of these motors, embodying new principles, have been devised by me and are being constantly perfected. On lighting stations, however, my three-wire system may be advantageously carried out. A third wire may be run for motors and the old connections left undisturbed. The armatures of the generators may be rewound, whereby the output of the machines will be increased about 35 per cent., or even more in machines with cast iron field magnets. If the machines are worked at the same capacity, this means an increased efficiency. If power is available at the station, the gain in current may be used in motors. Those who object to the third wire, may remember that the old two-wire direct system is almost entirely superseded by the three-wire system, yet my

three-wire system offers to the alternating system relatively greater advantages, than the three-wire direct possesses over the two-wire. Perhaps, if the writer in *Industries* would have taken all this in consideration, he would have been less hasty in his conclusions.

NIKOLA TESLA.

NEW YORK, Sept. 17, 1890.

REPORTS OF COMPANIES.

WESTINGHOUSE AND PULLMAN INTERESTS.

With regard to various reports current on the subject, it now transpires that arrangements have been made between George Westinghouse, Jr., of Pittsburgh, and George M. Pullman, of Chicago, by which the Westinghouse Electric Mfg. Company will erect works conveniently close to the Pullman Palace Car Works, at Pullman, Ill., and the agreement reached, it is understood, is that the Pullman company will purchase all of their electric railway motors from the Westinghouse concern. The works to be erected are to cost between $400,000 and $500,000, and Mr. Westinghouse says 2000 men will be employed at the new shops. Work on the structures will probably begin next spring. That the immense works of Pullman's Palace Car Company and the big plant of the Westinghouse Company, at Pittsburgh, are to be consolidated both Messrs. Pullman and Westinghouse deny. Mr. Westinghouse further says that the erection of works at Pullman does not mean that the Pittsburgh business of the company is to be removed to Chicago. It will be merely an extension of their business. The works at Newark, N. J., Pittsburgh, New York City, etc., will also be continued as before.

DIVIDENDS.

THE EDISON GENERAL ELECTRIC CO. has declared its fourth quarterly dividend of 2 per cent.

STOCKS AND BONDS.

ROYAL ELECTRIC CO.—Application will be made to the Legislature of the Province of Quebec to change the value of the shares of the Royal Electric Co. from ten to one hundred dollars each.

FINANCIAL MARKET.

QUOTATIONS ON ELECTRICAL STOCKS.

Mr. F. Z. Maguire, Electrical Securities of 18 Wall street, this city, reports the following quotations of September 19th from New York, Boston and Washington :—

NEW YORK.

	BID.		BID.
W. U. Tel. Co.	84¼	Edison Gen. Elec. Co.	99
American Tele. & Cable	83	Edison Gen. Co. Def'd	....
Centl. & So. Amer.	157	Conso.'d Elec. Lt. Co.	60
Mexican	205	Edison Illn'g Co. N. Y.	....
Com. Cable Co.	101¼	U. S. Elec. Lt. Co.	35
Postal Tel. Cable	39	North Am. Phonograph	50

BOSTON.

	BID.		BID.
Thomson-Houston	51¼	Ft. Wayne Co.	11¾
" Pref'd.	25¼	Am. Bell	225¼
" Series C.	12	Erie	48¾
" " D.	6	New England	51¼
" Int. Co.	....	Mexican	.90 cts
Thomson Welding Co.	..	Trop. American	..
Thomson Eu. Welding	70	Edison Phon'gph Doll	2

WASHINGTON.

	BID.		BID.
Penna. Telephone	25	U. S. Elec. Lt. (Wash)	170
Ches. & Pot. Telephone	71	Eck. & Sold. Home Elec. Ry	68
Amer. Graphophone	16¼		

PITTSBURGH.

	BID.
Westinghouse Electric and Manufacturing Co.	37¼

LEGAL NOTES.

BRUSH ELECTRIC CO. VS. SPRAGUE ELEC. R'Y & MOTOR CO.

The Brush Electric Co. has brought an action in the U. S. circuit court against the Sprague Electric Railway and Motor Co. of New York, to restrain them from selling or using a certain dynamo electric machine on the ground of infringement. The complainants set forth in their bill that C. F. Brush was the original and first inventor of a new and useful improvement in dynamo electric machines, which was secured by letters patent. About Jan. 1, 1887, Mr. Brush assigned all his right, title and interest in said machines to complainants in this action, such assignment being duly recorded in the U. S. patent office.

The suit in question is based on the patent issued to Charles F. Brush, No. 260,652, dated July 4th, 1882, entitled Dynamo-Electric Machine. The claims cover the application of a copper sleeve surrounding the field magnets of a dynamo-electric machine, whereby the insulation of the magnets is preserved from the high potential of self-induction created by fluctuations in the exciting current. The device is no longer used on the street car motors of the defendants, who now claim that its employment makes the magnets sluggish and causes burning out of the armature by retarding the generation of counter-electromotive force in it.

A PRIZE SCHEME OF LIGHTING.

Mr. F. H. Whipple has been awarded a prize of $100 at Davenport, Ia., for the best plan of lighting that city. Mr. Whipple, with native modesty, writes us from St. Louis that there was nothing special about the plans. Owing to the many hills and hollows in the town, it was difficult to light it economically. "There was nothing technical about it; but it was more the use of common sense in the location of lights."

TELEGRAPHY DURING THE COMMUNE.

One of the first things to be done after the recent disastrous fire at the New York offices of the Western Union Company was to re-establish the identity of each of the maze of wires running into the premises. Experienced electricians being on the spot, the task was not a very difficult one, and in a single day 300 circuits were restored. The ease with which this work was carried out at New York recalls to our mind, says *La Lumière Electrique*, a very instructive historic incident which occurred during the Commune. When the Republican Government quitted Paris, the operators at the central office in the Rue Grenelle managed to mix up all the wires before leaving. The Communists were so ignorant of everything connected with telegraphy, that it was beyond their powers to unravel the wires; and during the whole time that they were in possession of the building, namely, from the end of March to the end of May, they were only able to use the military lines. M. Fabre de Lagrange, who was forced to accept the appointment of chief electrician to the Commune, took good care to keep the wires in confusion; and among other services to the State, he sent misleading telegrams, and thus saved many public and private buildings which the rebels wished to blow up by using an explosive mixture of air and coal-gas. These facts were clearly authenticated by the court-martial which tried M. Lagrange, and he was honorably aquitted.

THE TROUVE ELECTRIC ERYGMATOSCOPE.

At a recent meeting of the Académie des Sciences, M. G. Trouvé described an electrical appliance devised by him to facilitate the inspection of the geological strata pierced by the boring tool. The apparatus consists of a powerful incandescent lamp enclosed in a cylinder. One of the hemicylindrical surfaces of this cylinder constitutes the reflector; whilst the other, which is of thick glass, allows the luminous rays to pass through it, and light up the successive strata through which the lamp descends. At the base of the instrument there is an elliptical mirror, while the top is open, so as to enable an observer placed at the head of the boring and armed with suitable glasses to see on the mirror the reflected image of the stratum illuminated by the lamp, which is arranged so that its upward rays are intercepted. The whole apparatus is suspended from a cable formed by the two conducting wires. This cable is wound on a drum, the trunnions of which are insulated from one another and connected to the leads, current being obtained by two rubbing contacts attached to the poles of a portable battery. This arrangement enables the instrument to be raised and lowered without difficulty and without interrupting the observations. The erygmatoscope as at present arranged gives excellent results down to a depth of over 600 feet, and with a more powerful lamp it could be used at still greater depths. An expedition which has been sent out to the Mozambique coast by the Portuguese government, to search for coal beds and other mineral deposits, has been supplied with erygmatoscopes.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

AT the meeting of the Council, on September 16, at the rooms of the Institute, 12 West Thirty-first street, the following gentlemen, being properly endorsed and qualified, were admitted to associate membership :—

Braddell, Alfred E., Electrical Inspector, Underwriters' Association, Middle Department, 308 Walnut Street, Philadelphia, Pa.
Knight, Wm. B., Civil Engineer (Specialty, Cable and Electric Railways), 200 West 6th Street, Kansas City, Mo.
Keen, William B., Electrician, The Clark Electric Co., 478 Pearl Street, New York City.
Taber, Robert B., Secretary and Electrical Engineer, New Bedford Gas Light Co., New Bedford, Mass.
McCay, H. K., Electrician, Edison Electric Light Co., Box 439, Birmingham, Ala.
Nesmith, S. D., Ohio Agent, United Edison Manufacturing Co., 822, Society for Savings Building, Cleveland, O.
Hewitt, Charles, Engineering Department, The Sprague Electric Railway and Motor Co., 278 Hicks Street, Brooklyn, N. Y.
Rodman, Samuel, Jr., Lieutenant 1st Artillery, U. S. A., Fort Columbus, N. Y. Harbor.
Forbes, Francis, Lawyer, 137 Broadway, New York City.
Tobey, William Boardman, Department Electrical Engineering, Cornell University, Student, Class of 1890.
Loomis, Osborn P., Electrician, Eureka Electric Co., 530 Nostrand Avenue, Brooklyn, N. Y.
Woolf, Alfred E., Electrician and Inventor, Woolf Electrical Co., 864 Lexington Avenue, New York City.
Atwood, George F., Edison Laboratory, Orange, N. J.
Binney, Harold, Assistant in the Practice of Patent Law, with Gilbert M. Plympton, 245 Broadway, New York City.
Putnam, H. St. Clair, Treasurer and Electrician, Thomson-Houston Carbon Co., Fremont, O.
Perrine, Frederic A. C., Superintendent Insulated Wire Department, John A. Roebling's Sons Co., 137 E. State Street, Trenton, N. J.
Merritt, Ernest, Instructor in Physics, Cornell University, Ithica, N. Y.
Hall, William P., President, The Hall Signal Co., 50 Broadway, New York City.

INVENTORS' RECORD.

Patents issued Sept. 16, 1890.

Alarms and Signals:—*Electro-Magnetic Bell*, John Geary, 436,410. *Electro Mechanical Gong*, G. Doyle, 436,560. *Electrical Automatic Fire Alarm System*, W. F. Singer, 436,640. *Municipal Signaling Apparatus*, J. W. Stover, 436,747.

Conductors, Conduits and Insulators:—*Electric Conductor*, W. E. Oehrle, 436,432. *Insulating Material*, J. W. Easton, 436,733.

Dynamos and Motors:—*Dynamo-Electric Machine*, S. D. Field, 436,408.

Galvanic and Thermo-Electric Batteries:—*Galvanic Battery*, J. F. Wollensak and W. E. Gill, 436,516.

Lamps and Appurtenances:—*Socket for Incandescent Electric Lamps*, H. E. Swift, 436,387. *Arc Lamp*, C. A. Tucker, 436,465. *Electrical Head-Light*, J. Thorne and E. B. Burr, 436,677.

Metal Working:—*Method of Electrically Heating Bars*, etc., M. W. Dewey, 436,519.

Miscellaneous:—*Electric Cigar Lighter*, M. M. Hayden, 436,354. *Electrical Switch*, F. De A. Goold, 436,412.

Railways and Appliances:—*Railway Signal*, P. C. Morse, 436,371. *Electric Railway*, H. W. Libley, 436,425. *Electric-Motor Car*, W. Robinson, 436,439 and 436,440. *Trolley for Electrical Railways*, D. A. Ainslie, 436,571. *Motor-Armature Car-Wheel*, E. Wagemann, 436,728. *Electric-Motor Car*, W. Robinson, 436,742.

Secondary Batteries:—*Storage Battery*, W. B. Hollingshead, 436,602.

Telegraphs:—*Printing Telegraph*, J. B. Odell, 436,740.

Telephones and Apparatus:—*Telephone*, W. Burnley, 436,334 and 436,335. *Telephone*, S. L. Wiegand, 436,512 and 436,513. *Telephone-Relay*, S. L. Wiegand, 436,514. *Graphophone*, J. Daniels, 436,576.

CLOSING UP THE VAN GESTEL CO.

Deputy Sheriff Carraher has sold out all the right, title, and interest of the Van Gestel Electric Street Car Company in the machinery, fixtures, etc., at 542 West Thirty-fourth street, this city, realizing about $250. Judgment for $1,688 was recently entered against the company in favor of R. R. Weiler. The company was incorporated in July, 1889, under West Virginia laws, with an authorized capital stock of $5,000,000, which was issued for patents on a street-car motor and storage battery, Henry M. Munsell being the president.

TRADE NOTES AND NOVELTIES AND MECHANICAL DEPARTMENT.

THE STANDARD ELECTRIC SUPPLY CO., OF BOSTON.

The above company has been formed in Boston with a capital stock of $100,000, buying out the partnership formerly carried on under the same name. The officers of the company are:—Mr. W. P. Fairbanks, president; Mr. W. C. Woodward, for many years connected with the Standard Electric Company, of Vermont, treasurer, and the directors will consist of these two along with Mr. T. B. A. Price. The purpose of the company is to handle all electric railway, light and power supplies, and their strong specialties will be the Kerite wires, cables and tapes, and the Solar carbons, manufactured by the Solar Carbon Manufacturing Company, of Pittsburgh, Pa. These carbons are made from the product of natural gas, being different from all other carbons in this respect. They will also carry a full line of the goods of the National Electric Manufacturing Company, of New York, and will sell the flexible brackets, controlled by the Hunt Engineering Company, of Brooklyn, N. Y., and the well known Hill switches and fuse devices. The Standard Company are already doing a large business in Kerite tapes and wires, the tapes especially being in great demand. Mr. Woodward has a host of friends, is deservedly popular, and is sure to make a success. Mr. E. O. Johnson has been connected with them for some time as salesman, and this week Mr. W. E. Sto.v, well known throughout New England, and who requires no introduction, has also accepted a position to represent them in the vicinity. Handsome offices and store room have been taken in the New England building, 180 Summer Street, Boston.

ACCUMULATORS AT THE RESIDENCE OF VICE PRESIDENT MORTON.

Some time ago a plant of the Sawyer-Man incandescent system was installed at the country residence of Vice President Levi P. Morton, Ellerslie, Rhinecliff-on-Hudson. Mr. B. W. Philbrick, engineer in charge, now reports as follows to Mr. D. H. Bates, of the Electrical Accumulator Co., 44 Broadway :—

"In reply to your inquiry respecting the electric lighting on Mr. Morton's place, I beg to say that the plant has been in operation for over two years and is in as good condition to-day, apparently, as when first installed. It has given no trouble whatever outside of ordinary care and has cost practically nothing for repairs. The lights have given entire satisfaction and the accumulators have never failed to furnish the required energy. This system of lighting compares very favorably with gas in point of economy and has the advantage of being free from smoke and heat, besides affording a most agreeable light. There is a large saving as compared with the cost of running the engine all the time, in labor, fuel and wear and tear on the machinery. In other words, Mr. Morton has found the system very satisfactory in every way."

THE CONNECTICUT MOTOR CO.

The new catalogue and price list issued by the Connecticut Motor Co., of Plantsville, Conn., is much more than its name implies, a large portion of its contents being devoted to a discussion of motor work and an excellent technical discription of the motor itself. Numerous illustrations are given of the motor and details, and these are accompanied by figures of the amount of power required for various classes of work, including H. B. Prindle's article on "Electric Power for Small Plants"; A. T. Snell's "Nominal Outputs of Two-Pole Dynamos and Motors"; and the same gentleman's "Electric Traction Calculations." At the end are cited a large number of testimonials from users of Connecticut motors as to good results obtained with them.

THE CROSBY ELECTRIC CO.

Mr. Louis Walsh, who was formerly connected with the Daft Electric Light Co. during a period of four years, has now joined the forces of the Crosby Electric Co., and will be their representative among the trade in handling their well-known dry battery and other specialties. Mr. Walsh has a high reputation for energy and ability, which he proposes to enhance in his new sphere of labor.

THE BAKER COMMON SENSE OIL FILTER.

Mr. Walter E. Crane, of 421 Thirteenth avenue, S. E., Minneapolis, reports excellent success with his Baker common sense oil filter among electric light people, and he has been enjoying a brisk run of orders. This filter, which is shown in our advertis-

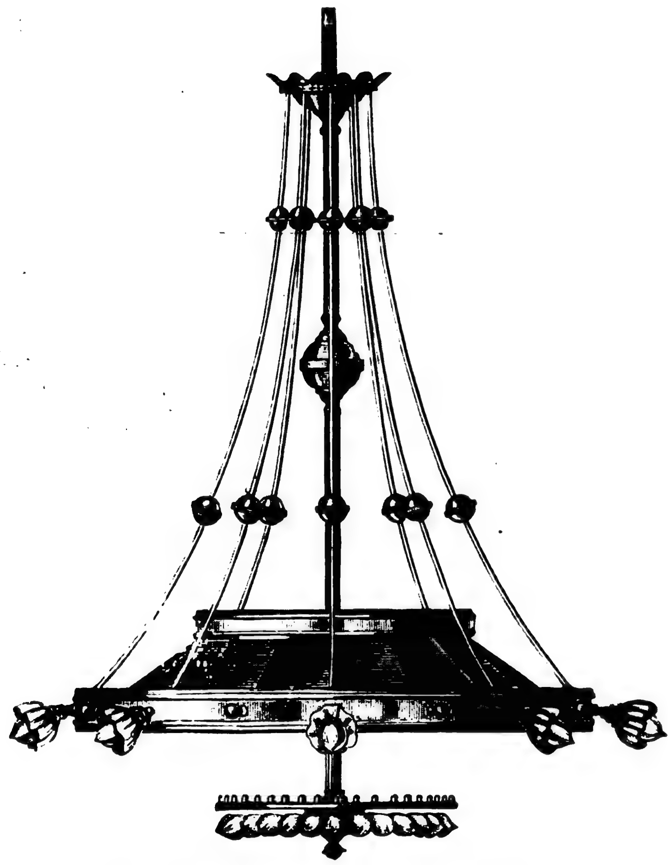
ing columns, and has been fully described in these pages, is one in which the whole process of filtration can be watched. The oil thus treated can be used over and over again indefinitely, and as the apparatus is cheap, it pays for itself many times over in a single year.

A. G. DAY CABLE WORKS EXCURSION.

W. R. Brixey, superintendent of the A. G. Day Cable Works, at Seymour, Conn., gave the employés, to the number of sixty or more, an excursion to Seaside Park, Bridgeport, and a first-class shore dinner Saturday, Sept. 13. The day was passed most pleasantly by all and will be an occasion long to be remembered by the participants. They returned by the evening train.

A NEW "FRINK" ELECTRIC LIGHT REFLECTOR.

Mr. I. P. Frink, 551 Pearl street, this city, whose reflectors are so well-known, has lately been devoting attention to electric lighting as well as gas. Now that the electric light has been so generally introduced, it has been found necessary to use his system of reflectors with the incandescent electric light; he has, therefore,



NEW FRINK ELECTRIC LIGHT REFLECTOR.

issued a catalogue containing a variety of reflectors to be used with incandescent lamps, one of which, 1152 E., we illustrate. This represents a fixture containing one of his double cone reflectors, lined with silver-plated corrugated glass, with a cluster of gas lights and one of incandescent lamps underneath, to thoroughly illuminate and evenly diffuse the light in any large audience room. It also has attached electric lamps on the outer rim, giving it the appearance of an electrolier.

Mr. Frink is now executing orders for the finer class of reflectors to be used with electric light for churches in Wilmington, N. C.; Goldsboro, N. C.; Spokane Falls, Wash.; Montesano, Wash.; Columbus, Ga.; Newburgh, N. Y.; Middletown, N. Y., and Hackettstown, N. J.

FIRE IN THE W. U. OFFICE AT LYNCHBURG, VA.

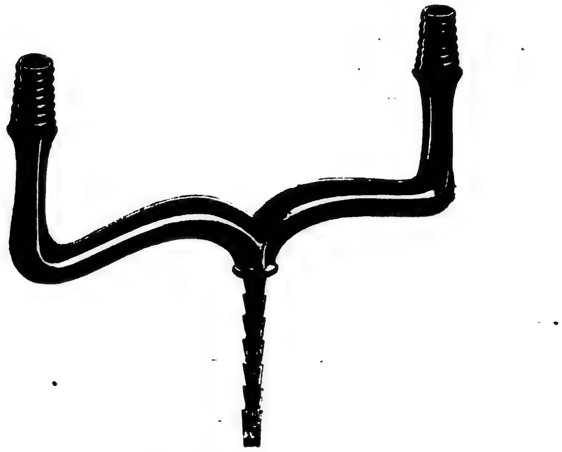
A very destructive fire occurred at Lynchburg, Va., on Sept. 14. Fire was first discovered in the battery room of the Western Union Telegraph office, and spread so rapidly that nothing was saved belonging to the office. The flames quickly spread to the adjoining buildings, and half a block was destroyed. The estimated total loss on buildings and stock will amount to $150,000. No estimate of insurance can be made.

T. McCOUBRAY.

The above named gentleman, who is so well known in electrical circles, has severed his connection with the Crocker-Wheeler Motor Co., with whom he has been associated for some time past as secretary and general sales agent. He has joined the forces of the Okonite Co., and will enter upon active service with that concern at the beginning of October. Mr. McCoubray's new duties will be largely those of a special agent in looking after the interests of the company in all parts of the country, and his wide acquaintance ensures for him a welcome everywhere.

A NOVEL BREAK ARM.

In the varied electrical industries, as in other mechanical lines, the old and heavy cast iron appliances are being supplanted by lighter and neater ones of wrought or malleable iron. Quite recently we described a malleable iron wall-bracket, made by the Great Western Electric Supply Co., which marks another step in this direction. The same firm is now putting out the Chubbuck break arm, which is also made of malleable iron, and is claimed to be stronger, lighter and tougher than the forms now in use. Our illustration shows the rather neat design, with the strengthening rib and taper screw as in the Chubbuck (Springfield) bracket. The star shaped section of the arm gives great strength, while the hollow split screws have a slight spring and grip the insulator firmly. Another new feature is the small barbed pin used. As



A NOVEL BREAK ARM.

this is made for a ⅝ inch hole, the cross arm is weakened much less than by the 1⅛ inch holes needed for other break arms. Moreover, when once driven in, the barbs catch in the wood, holding the arm firmly in its place.

THE JEROME KIDDER MEDICAL BATTERIES.

The Jerome Kidder Mfg. Co., of 820 Broadway, are in receipt of the following letter, dated August 8, 1890, from Henry Gerard, the publisher and proprietor of the *Manufacturer & Builder*, of this city: "I was taken in October last with a severe nervous disorder characterized by my physician as a depression of the sensory nerves. I tried medicine, the application of iodine to the spine as a counter-irritant, and rubbing. These benefited me only partially. My physician advised me to get a medical electric battery, and I ordered one of your $27 machines. It effected wonders, and I improved rapidly under its use until I am now in perfect physical health. My observation, however, leads me to say that the battery should be used daily (I used it 5 minutes each day just before retiring) until a cure is effected, otherwise it cannot be fully effective. I found the best application to be to the hands; and at the base of the brain or back of the neck. In the latter case the positive pole at the neck and the negative at the feet; running the sponge down the spine was not necessary."

BUILDING THE SIOUX CITY CORN PALACE.

The convenience of the electric motor is being shown to the crowds which watch the Sioux City, Ia., Corn Palace, now in course of construction.

About fifteen thousand bushels of corn are used to decorate the building. Last year, the saws to split the corn were run by four horses, and the irregular speed caused much annoyance to those feeding. This year a three-horse power Hawkeye motor, belted direct to a saw, does all the work much more satisfactorily. One man saws about sixty bushels an hour to supply over two hundred men and about the same number of women, who are decorating the building.

For working at night, the immense structure is illuminated by fifty arc and over one thousand incandescent lights.

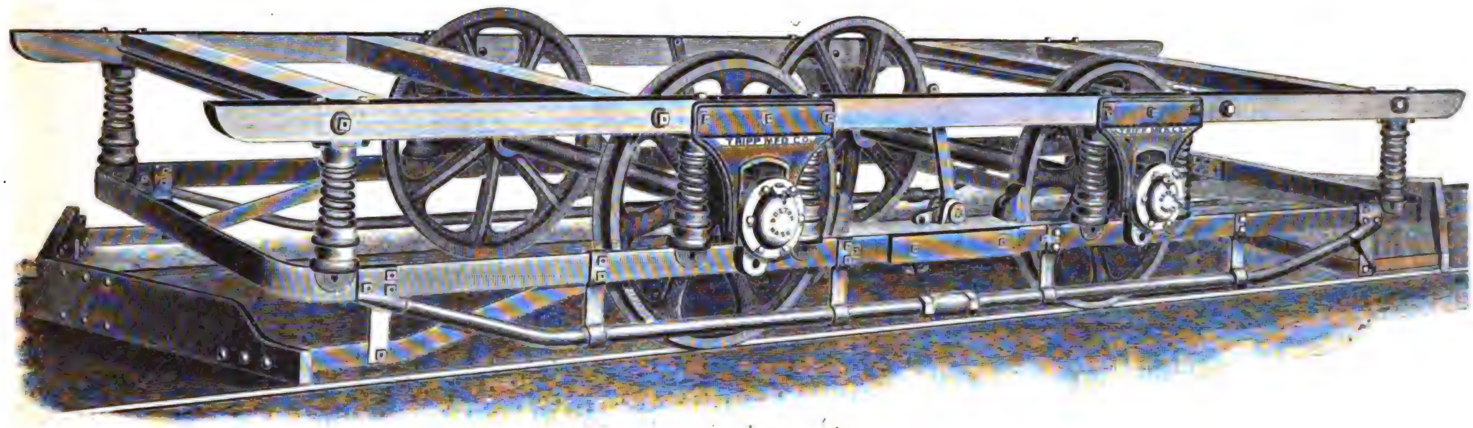
THE TRIPP ELECTRIC TRUCK FOR 18-FOOT CARS.

We illustrate this week another form of truck manufactured by the Tripp Manufacturing Co., of Boston, designed specially for long 18-foot cars. It differs from the truck described in our issue of August 20, in that it has a strong bottom truss, and top rail, so as to support the extra length. In all other respects it is the same, and has all the good points of the other, being fitted with the Tripp patent anti-friction roller-bearings.

The Tripp Manufacturing Co., of Boston, the extensive manufacturers of electric car trucks, to accomodate their rapidly increasing business, are about to increase their plant, by doubling their capacity. This plan will be immediately carried into effect, and their force largely increased, which will enable them to fill all orders with dispatch. This company manufacture every variety of trucks for electric cable and steam cars, which are equipped with Tripp's anti-friction journal bearings, which are noteworthy for saving in power effected, as well as being absolutely dust proof. The leading railways of the country indorse these trucks.

The city of Boston recently contracted with the Tripp Manufacturing Co. for their celebrated anti-friction journal bearings for the equipment of the large Federal street draw bridge, which is being re-built at great expense. Undoubtedly the same bearings will be placed under the various street bridges of that city at an early date.

The Tripp Company are now represented in the West by Samuel A. Randall, Sup't., who is on a business trip to Chicago and other Western cities, and Martin J. Deviney, salesman, who is on the Pacific Coast, where many large orders are being secured.



The Tripp Electric Truck for 18-Foot Cars.

It is worthy of mention also that the Tripp Manufacturing Co., of Boston, who are the sole manufacturers of the "Tripp Metallic Packing," which has been adopted by leading corporations of New England and the Middle States, are now shipping to customers in Canada and Great Britain, where a large business is assured. The company is now represented by agencies in all the principal cities of the United States and Canada; also in London and Liverpool, England, and Glasgow, Scotland.

WORK OF THE CONSOLIDATED ELECTRIC STORAGE COMPANY.

The Consolidated Electric Storage Company has appointed the following agents: Mr. Henry C. Eddy, 170 La Salle street, Chicago, Ill.; Messrs. Bemis & Perry, 21 Old Sentinel Building, Indianapolis, Ind.; Mr. H. P. Broughton, 401 Mermod-Jaccard Building, St. Louis, Mo. These agents are going actively into the work of storage battery installation for lighting and power.

We have seen recently the detailed record of the work the storage battery cars are now doing on Fourth and Madison avenues. It brings out remarkably few accidents and stoppages. There are nine cars now in service. Beginning with the 1st of October the cars running between midnight and the morning service will be exclusively electric cars. They will then have an opportunity of showing how much they can shorten the horse-car schedule between Eighty-sixth street and the post office, as they will have a free track.

A letter from Mr. Pritchard, the engineer in charge at Birmingham, England, states that the twelve Julien cars now in regular service there are doing good work. Storage battery traction is being rapidly pushed in New Orleans; eight (8) cars have just been received there from Brill & Co., to be followed by twenty-two (22) more. Thirty cars in all are to be installed within the next few months. Thirty trucks are already mounted with motors and prepared to receive the car bodies.

The Consolidated Electric Storage Company has got up a very handsome accumulator for phonograph work. The accumulator is placed in a hardwood box so as to accord in style with the phonograph box. The box is water tight, so that the accumulator may be shipped charged without fear of spilling the solution. It is carried by a leather strap, somewhat similar to a shawl strap. The capacity of the accumulator is from 260 to 300 ampere hours, and weighs, including the box, about forty-two (42) pounds.

SOME NEW WESTINGHOUSE WORK.

The Westinghouse Electric and Manufacturing Company has just obtained the contract from the Citizens' Electric Light and Power Company, of Blairsville, Pa., to light up that town. The contract was secured under the severest kind of competition; it is said there is not a company in the country which did not bid upon it, and the fact that the contract was given to the Westinghouse Company speaks volumes for their alternate current system, especially because the Westinghouse people entered the contest with the second highest figure. In order to assure themselves that the company would get the best system of electric lighting, a committee of seven was appointed with a view of making a personal investigation in several towns and cities where electric lights are now in use. This committee traveled to Altoona, Elizabeth, Tarentum, Allegheny and Pittsburgh, Pa. What they saw evidently convinced them that the Westinghouse system suited their purpose, and the contract was made. The plant will start with a capacity of 750 incandescent and 40 arc lights, but the company expects to increase this almost immediately.

The Newark, N. J., Electric Light and Power Company has been operating the Westinghouse alternating system for more than a year. In all this time the service of the company has been of such a character as to constantly grow in public favor. As a natural result of this fact, the company is now obliged to make extensive additions to its plant. When the plant was first operated 2,250 incandescent lamps seemed to be sufficient to supply all demands. However, the superiority of electric lighting over any other illuminant has since been demonstrated so largely that to-day the plant has to be more than doubled. The contract for 3,000 lights was awarded the Westinghouse Electric and Manufacturing Company a few days ago, and the apparatus is to be installed immediately.

The central station plant of alternate current incandescent lighting at Windsor Locks, Conn., is being enlarged, and the capacity of the plant will be increased 750 lights, making the total capacity 1,250 lights. The company is operating the Westinghouse alternate system, and the Westinghouse Company is now engaged in installing the additional apparatus.

The new Westinghouse motor, which has been in operation on the Pleasant Valley electric railway, Allegheny, Pa., for a week, has been the subject of daily conversation among parties interested in the electric motor business. The patrons of the road are perfectly delighted with it. They have named it the "Noiseless," and it is not an unusual thing for people to let several cars go by and wait for No. 130, the car fitted up with the Westinghouse motor. One of the officials of the Pleasant Valley Company, who has made the electric motor a study, and who has had experience with all of them, in answer to a series of questions as to the distinctive points of the Pittsburgh street car motor, said:—

"There is above all the wonderful ease and quietness of operation, which causes the cars to run along with a wonderful smoothness and silence. This noiselessness makes the car at once conspicuous on our line, and there is hardly a passenger on the route to-day who does not know the 'Noiseless.' People are enabled to converse even in an ordinary tone of voice on the car, and the residents along the line are in great praise of it. The car has been running 167 miles each day since the first day of its operation,

which is 47 miles a day more than any other car runs. That is, of course, because we run the car all night, and thus are able to accommodate the traveling public without having our cars become a nuisance to the people who are desirous of having a night's rest undisturbed by the rattling and grating of the street car motor. I also think the Westinghouse motor superior in its construction. All the details are far stronger than any other, especially the fields and the armature. Another noticeable feature is that the 'Noiseless' starts with the greatest ease while the other cars start with a sudden jerk, which is very objectionable to the passengers. I agree with Mr. Henry, the president of our road, who says that the Westinghouse street car motor is the best to-day. Noise has been the great objection to all motors and we have introduced the rawhide pinions on our ordinary cars; even then they are not nearly so noiseless as the Westinghouse motor."

The business of the Westinghouse Electric Manufacturing Company has received, it is stated, an extraordinary boom during the last month. The shops are now running at their full capacity day and night, and the company has still orders ahead to keep it busy the entire winter. This large increase in the work is especially caused by the wonderful success of the street car motor lately brought out. Several roads have been equipped already and their operation has proved to give more than ordinary satisfaction.

The manufacture of alternating current apparatus has also gained considerably, and the new Westinghouse system of alternating current arc lighting is rapidly becoming the popular method of illumination. Among the contracts the company has recently obtained are St. Paul, Minn., for an increase of apparatus to the extent of three thousand incandescent lights' capacity; Arlington Heights, Texas, five hundred lights; Rochester, Pa , an increase of five hundred lights, and Colorado Springs, Colorado, an increase of fifteen hundred lights.

ST. LOUIS TRADE NOTES.

THE COLUMBIA INCANDESCENT LAMP CO., who began here in a quiet and unpretentious way a year ago, have built up a substantial business, and have lately moved into commodious quarters at 1912-1914 Olive street. They manufacture lamps of any voltage and for all systems, the vacuum being very complete, a mercury test showing an air bubble the size of a pin point. Seventeen hundred of their lamps are in use at the Exposition Building. The company will shortly increase their capital stock from $16,000 to $50,000 and will increase their manufacturing facilities. Mr. J. H. Rhotehamel is president and general manager of the company.

MR. GUIDO PANTALEONI, Western representative of the Westinghouse Electric Co., has closed contracts for the complete installation of 20 motor cars for the Waco Texas Street Railway, 10 cars for the Ogden, Utah, Street Railway, 750 lights for Joplin, Mo., 750 lights for Carthage, Mo., and an increase of 750 lights for Sedalia, Mo.

THE SOUTHWESTERN ELECTRIC ENGINEERING CO. are doing a large business in wiring and installations. The Exposition building has been wired by them for 1000 additional lights and a new switch board erected. They are now engaged in wiring the Boatman's Bank for 1200 incandescent lights and 60 arcs, also an elaborate system of call bells for bank purposes. Hard rubber tubing will be used throughout. The Thompson building is being wired for 500 incandescent lights. They are also laying all the underground wires for the St. Louis Automatic Refrigerator Co., and three floors of Odd Fellows Hall are being wired for 500 lights. Outside the city they are installing 500 incandescent lights at Hiawatha, Kan.

WESTERN TRADE NOTES.

THE CHICAGO EXPOSITION.—Among the electrical attractions of the Chicago Exhibition is the varied display of fixtures, telegraph instruments and house goods by the Great Western Electric Supply Co. A sign made of cleats, and another made of colored shades are novel, and like the elk-head electrolier, which lights this exhibit, are much admired. The assortment of linemen's tools shown, also seems to catch the eye of the electrical people who visit the exposition. The same firm also has a display of its specialties at the St. Louis exhibition, in charge of Mr. G. T. Hewes.

THE FLEMING BUILDING, Washington & Montague streets, Jersey City, was struck by lightning on the morning of the 17th inst. The New York and New Jersey Telephone Co. occupied the top floor, and on the first alarm the 18 girls employed made a hasty escape. The arresters were destroyed and wires much tangled. Loss, $2,000.

STEALING TELEGRAPH WIRE.

Six employés of the city fire-alarm service have been held in the Criminal Court, Chicago, to answer to the charge of larceny. They are charged with stealing between 3,000 and 4 000 pounds of copper wire from the American Telephone and Telegraph Company, which operates the service of long-distance telephony. The thefts were accomplished by removing the poles of the company.

NEW ENGLAND TRADE NOTES.

THE UNION ELECTRIC CAR CO., of Boston, are building three more cars for immediate service on the Beverly and Danvers street railway. The two cars which have been running on that road for nearly a year have given great satisfaction, and they are now running on the Naumkeag tracks, a short distance in Beverly, and also from Danversport to Danvers Plains. The Union Electric Car Company are also building six of their cars to run on a new road in a Massachusetts town, which will be fitted in the same way with storage batteries and the Stevens patent gearing.

MR. CHARLES E. ROWE, for many years connected with the electric supply business, has opened an office on his own account at room 412, Shoe and Leather Exchange Building, Bedford and Kingston streets, Boston. His specialties at present will be the Sanford electric protector and lighting arrester and the Pumpelly storage battery, and he will also do general electric construction work.

THE JOHN BECKER MANUFACTURING CO., of 157 Pearl street, Boston, are making a specialty of furnishing electrical manufacturers with neatly designed name plates for dynamos, motors, and all kinds of electrical apparatus, and are reaping a rich harvest in this specialty. This firm produces the best work in this line to be had, and they can refer to nearly every electric manufacturing company, and most of the largest machinery manufacturing concerns in the United States. They manufacture every style and design of name plate in either nickel or bronze. Their factory is particularly well adapted for this class of work, Mr. Becker having a wide reputation for fine light castings, and having a particularly fine lot of machinery for executing tasteful designs. The beauty of all machines is much enhanced by a suitable name plate, and a large variety of designs can always be seen at their office.

THE EASTERN ELECTRIC LIGHT AND STORAGE BATTERY CO., at Lowell, has supplied the Sorley storage battery for lighting the Lawrence Mills, White Bros. & Co., Lowell Bleachery, Traders' and Mechanics' Insurance Co., Lowell; J. M. Sears' private residence, Southbridge; F. L. Ames' residence, North Easton; and has several orders on hand, including orders for installing batteries in Abbot Academy, Andover; Howland Mills Manufacturing Co., New Bedford, etc.

J. A. GRANT & COMPANY, Boston, are filling an order for a complete steam plant for electrical purposes at Zacatecas, Mexico, consisting of boilers, McIntosh and Seymour engines, pumps, feed-water heaters, etc.

THE WRIGHT ELECTRICAL ENGINEERING COMPANY, Boston, have made a contract with the Clinton Gas Light Company, Clinton, Mass., for the line work to accomodate 120 series 25 c. p. lamps, and 30 1,200 c. p. arc lamps. About 550 poles will be used, and 27 miles of wire furnished by the American Circular Loom Company, of Boston. The Wright Company will also wire the station and furnish the slate switchboard, the arc and the alternating incandescent lights.

THE STANDARD ELECTRIC COMPANY, of Vermont, have received through the Hunt Engineering Company, of Brooklyn, N. Y., their New York agents, the contract for furnishing two 500-light dynamos for the Broadway Theatre, at Norwich, Conn. The wiring will be done by the Hunt Engineering Company.

THE PETTINGELL-ANDREWS COMPANY are having quite a run on their new socket to fit Thomson-Houston lamps. It is extremely simple in its action. They have sold in the past few weeks no fewer than 50,000 of these sockets, which are giving great satisfaction. They are also selling in large quantities the tested fuse wires of the Massachusetts Engineering Company, and are enjoying a large sale of the new Bryant switches. Okonite is also in large demand, and the Pettingell-Andrews Company have now one of the largest stocks of insulated wire ready for immediate shipment in the country.

THE ROBINSON ELECTRIC TRUCK AND SUPPLY COMPANY has been formed as a sub-company of the Robinson Radial Car Company, to operate under license for the construction of the Robinson radial car trucks for street railway work. The company are making arrangements for the necessary works and will most probably erect a factory in Lynn.

THE

Electrical Engineer.

VOL. X. OCTOBER 1, 1890. No. 126.

LIEUT. FISKE'S NEW RANGE FINDER.

THE importance of being able to determine the exact position and range of an object to be fired at, whether from a fort or war vessel, is too obvious to need further exemplification, and hence a ready means of determining this point is evidently of the utmost practical importance in gunnery. As our readers may be aware, Lieut. Bradley A. Fiske, U. S. Navy, has devoted considerable attention to this subject, and has designed a variety of forms of these instruments. His most recent work in this branch is a range finder which embodies a decidedly novel application of the Wheatstone

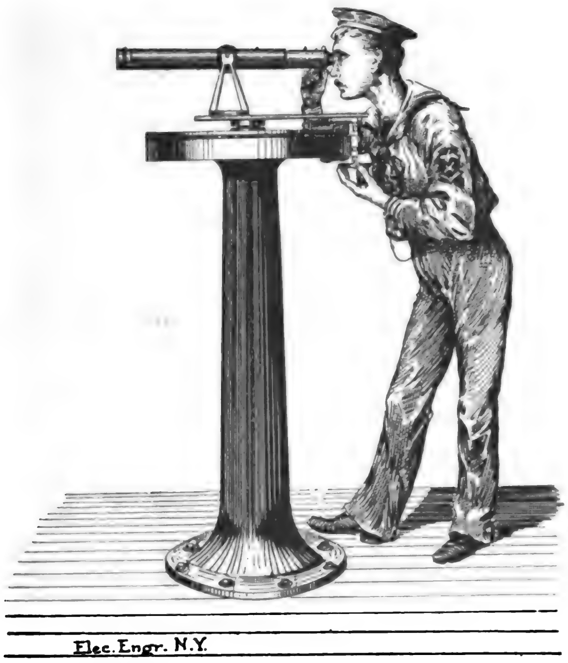


FIG. 1.—LIEUT. FISKE'S RANGE FINDER IN POSITION.

bridge as a means of measuring the angles, and by means of which ranges or distances can be read directly from a scale.

Broadly considered, Lieut. Fiske's latest method consists in determining a fractional portion of a conductor bearing in length a ratio to the angle included between two lines of sight directed upon a distant object, and simultaneously causing a disturbance in an electrical balance, including the conductor in its circuit, proportional to the resistance of the fractional portion, and observing the difference in potential due to the disturbance.

The accompanying diagram, Fig. 2, illustrates the simple and ingenious manner in which this is carried out. We will suppose AB to be a base line, and T the position of a distant object, the range of which AT is to be determined. By trigonometry, in the triangle ATB,

$$A\,T = \frac{AB}{\sin ATB} \times \sin ABT.$$

Let C and D represent two telescopes pivoted at the points A and B and sweeping over arcs E and F of conducting material, the arcs having their extremities upon the base line AB. Let the telescope C be directed upon the point T, assuming the position represented by C', in dotted lines. Then obviously, the angle $C'A\,C$ is equal to the angle $A\,TB$ and the portion of the arc E included between the positions C and C' of the telescope, will measure the angle at $A\,TB$.

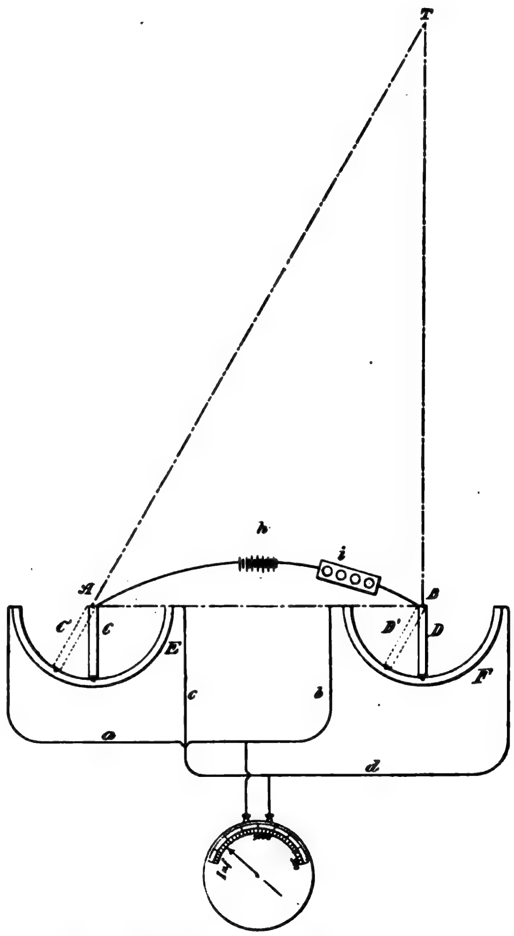


FIG. 2.—METHOD OF USING THE FISKE RANGE FINDER.

In the foregoing formula, the base line $A\,B$ is known by measurement, and the angle $A\,B\,T$ may be observed; and if the angle $A\,B\,T$ is, as shown in Fig. 2, a right angle, then the sin $A\,B\,T$ becomes unity. It remains, therefore, to find the angle $A\,TB$ in order to determine the distance $A\,T$; so that it becomes necessary to provide a simple and rapid means of at once determining what the angle $A\,TB$ is. To this end, the conducting arcs E, F, are connected in the manner of a Wheatstone bridge, the four members of which are shown respectively at a, b, c, d. In this bridge is connected a galvanometer in the usual way, and also the battery h; the terminals of the battery wire being connected to the telescopes at their pivot points A, B, so that

the circuit proceeds through the telescopes to the arcs, and then at the arc F divides through the wires b, d, and at the arc E divides through the wires a, c.

It will be plain that when the two telescopes C and D stand at right angles to the base line, and hence parallel to each other, the bridge will balance, and the galvanometer will show no deflection. The lines of sight of the two telescopes then being parallel, the galvanometer will then indicate infinite range; and of course, this will be true no matter where the telescopes may be on their respective arcs, so long as their lines of sight are relatively parallel. But if one telescope be moved out of parallelism with the other, as for example, the telescope C moved to the position C', then clearly the bridge will be thrown out of balance, and the galvanometer will be deflected. It will also be clear that the extent of deflection of the galvanometer will depend upon the length of arc included between the two positions of the telescope, C, C', and will be greater as that arc increases; so that with a battery of constant electromotive force, it becomes possible to determine the extent of movement of the telescope C by simply observing the indication of the galvanometer.

It will of course be obvious, that as the angle between the positions C and C' of the telescope increases, the length of the line $A\ T$ will constantly decrease, while the deflection of the galvanometer will constantly increase; so that the galvanometer indicates ranges starting from infinity when the galvanometer shows no deflection, small ranges being indicated by large deflections of the galvanometer, and *vice versa*. As a matter of convenience, Lieut. Fiske employs for this purpose a galvanometer so constructed that the deflections of the index will be proportional to the differences of potential at the terminals.

It will be clear that by the method just described the operation of finding the range is reduced to a very easy and rapid process, and at the same time, greatly simplified as regards apparatus.

Observers stationed at the two telescopes C and D align them with the distant object, when a third observer instantly reads the range from the galvanometer, which is provided with a scale suitably marked in linear units, such as yards.

If, however, the angle $A\ B\ T$ is not a right angle, then the factor, sin $A\ B\ T$, must be taken into consideration in solving the formula, $A\ T = \dfrac{A\ B}{\sin A\ T B} \times \sin A\ B\ T.$

Or, in other words, the observer at the galvanometer may simply multiply the range indication by the sin $A\ B\ T$ numerically expressed, in order to reduce the indicated range to the true range. The angle, $A\ B\ T$, is observed directly on the arc F.

In the foregoing demonstration, it is assumed that the resistance in the circuit remains constant, that is, remains the same as it is when the two telescopes are parallel to each other, and stand in the positions, $C\ D$, touching the middle parts of their arcs. But, as a matter of fact, this resistance does not remain the same when the telescopes move to positions nearer the extremities of the arcs. To illustrate, if the resistance of the circuit is a certain amount with the telescopes in the position $C\ D$, it will be less when the telescopes are turned in the position, $C'\ D'$. Now, the variation of resistance due to this change of position will affect the total resistance in circuit to an extent depending upon its ratio to the resistance of the whole circuit. And, consequently, if that ratio be made very small, as it easily may be by simply introducing a high resistance in the battery loop at i between the points A and B, then, inasmuch as the variation in resistance due to change in position of the telescopes may thus be rendered inappreciable, the total resistance of the circuit may be taken as constant; so that, despite the fact that the angle, $A\ B\ T$, differs from a right angle, the deflection of the galvanometer, as before, will remain practically constant for any given angle, $A\ T B$.

It is evident that if the high resistance before mentioned be not put in the battery loop, then the decrease in resistance due to change in position of the telescopes from the middle point of their arcs toward the extremities of the arcs may bear a considerable ratio to the resistance of the whole circuit. And as this decrease in resistance will be attended by corresponding increase in current strength, it follows that proportionately greater deflections of the galvanometer will follow for any given angle, $A\ T\ B$; so that, consequently, the ranges indicated by the galvanometer will be less than those which would have been shown had the high resistance been put in the battery loop. Again, if the resistance of the battery loop between A and B is extremely small with relation to the rest of the circuit, the decreasing resistance of the whole circuit, due to change in position of the telescopes, may become very large; and this result may be intensified if the members a, b, c, d, connecting the arcs, are connected to those arcs at points less than 90 degrees from the middle points of those arcs. If, for instance, these wires were connected to the arcs at points 81 degrees removed from the middle points, and if the resistance in the battery loop were one-tenth of the arc of 81 degrees, then when both telescopes were moved to positions 60 degrees from the middle points, the resistance of the whole circuit would then be only about half of what it was when the telescopes were at the middle parts or the positions $C\ D$. Consequently, for any given relative angular displacement of the telescopes occurring 60 degrees away from the middle points of the arcs, the corresponding deflection of the galvanometer would be about twice as great as if the same relative angular displacement occurred when the telescopes were near the middle points of the arc; so that the range indicated in the latter case would be about half as great as in the former.

But it will be observed that if the telescope, D, for instance, were 60 degrees removed from the central position, the angle $A\ B\ T$ would be 30 degrees, or 150 degrees, and then its sine would be one-half; so that the range indication for any given angle $A\ TB$, would be only one-half of what it would be with the same angle $A\ TB$ when the telescope at D' is in its middle position. In other words, the fact of the decreased resistance caused in the circuit as the telescopes move away from the middle position, tends to automatically make the very correction for the sine of $A\ B\ T$ which ought to be introduced, because the telescope no longer stands at 90 degrees to the base line; and this is found to be the actual occurrence in practice.

In what has been said above, the resistance of the galvanometer has been neglected, and it has been assumed that the E. M. F. and internal resistance of the battery, and the resistance of the various contacts, remain constant. While this is not theoretically true, Lieut. Fiske finds that by using storage batteries and by making the contacts carefully, no appreciable error is introduced. Careful experiments with this range finder at sea, show that the errors of the instrument are insignificant and the indications absolutely instantaneous.

Fig. 1 shows the range finder as actually used on shipboard. The instruments are made of aluminum, bronze and iron, and are left exposed on deck without any protection whatever, except that a cover is placed over the telescope when not in use. The instruments require no care except an occasional cleaning.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the meeting of Council, held September 16th, Messrs. E. M. Barton, A. H. Bauer and E. M. Izard, of Chicago, were appointed as a committee of three to represent the Institute at a meeting of various engineering societies, to be held in Chicago, October 14th, under the auspices of the Western Society of Engineers. The object of this meeting is to organize an International Engineering Conference, to be held in conjunction with the Columbian Exposition in 1893.

NEW STREET RAILWAY MOTOR OF THE UNITED ELECTRIC TRACTION COMPANY.

WE illustrate herewith, in Figs. 1 and 2, the new 30 h. p. railway type motor of the United Electric Traction Co., of this city, with its gearing in position, mounted on one axle of the car. The other extremity of the motor, attached to which is seen an iron ring, is adapted to be suspended on a bearing on the other axle, not shown. This other bearing is about 8 inches long and has an end play on its axle regulated by means of two collars, which is sufficient to give the suspension flexibility when the motor is going around curves or in other difficult places. Figs. 3 and 4, page 355, give an upper and lower view of the end casting, which attaches the motor to the driven axle. This casting is made of gun steel and is provided with oil reservoirs and chain pumps, keeping the bearings flooded in oil while the motor is running. The I beam shown in Fig. 3 and also in Figs. 1 and 2, is of forged steel bolted to the casting at the back and reaching around the motor, supporting the front end of it. The motor fields, as may be seen from the illustrations, are built up of bars of Swedish wrought iron, securing a very high degree of efficiency, both from the quality of the metal and the lamination resulting from this form of structure. The armature is of the Gramme type, wound in a large number of sections. It is built up of a core of iron wire. The winding is so arranged that considerable ventilating space is left, and so that one or more sections can be very easily and cheaply removed and replaced. The regulation of the motor is secured by the use of a cumulative winding on the fields. For starting, a small rheostat is used to prevent the shock to the gearing which follows a sudden starting of the motor. The gearing consists of two gears of gun steel, cast and carefully tested before cutting. The two pinions are cut from blanks of forged steel of very high quality. This work of gear cutting is done with great accuracy by special cutting machines in the company's shops. It will be noticed that the armature can be removed by simply unkeying the armature pinion and removing four bolts from the bronze spider at the other end of the armature shaft. This is a matter of considerable importance where repairs to the armature are necessary.

The starting mechanism furnished in connection with these motors is of very simple character, and is operated from either platform of the car by means of a simple mechanical connection. The space occupied on the platforms is reduced to a minimum by this arrangement. The field coils of the motor are wound upon spools of peculiarly rigid construction, are covered with heavy canvas and are thoroughly waterproofed. Every part of the motor as described above, except the steel castings, is made in the United Electric Traction Co.'s shops, at Jersey City, and all parts are made interchangeable upon United States government standards to 1-1000 of an inch. The capacity of the Works has been recently enlarged and they are now turning out car motors of this type at the rate of about one a day. The standard type of 20 h. p. motor is similar to the above, only smaller. A new standard for storage battery work where two motors are required on a car is shortly to appear.

It may be mentioned in connection with the foregoing that it has been found that suspending the motor directly from the two axles by a more or less elastic suspension almost entirely does away with the noise which is heard when the motor is attached to the truck frame or to any part of the car body or truck above the springs, the car body being in this case a resonator to magnify the noise.

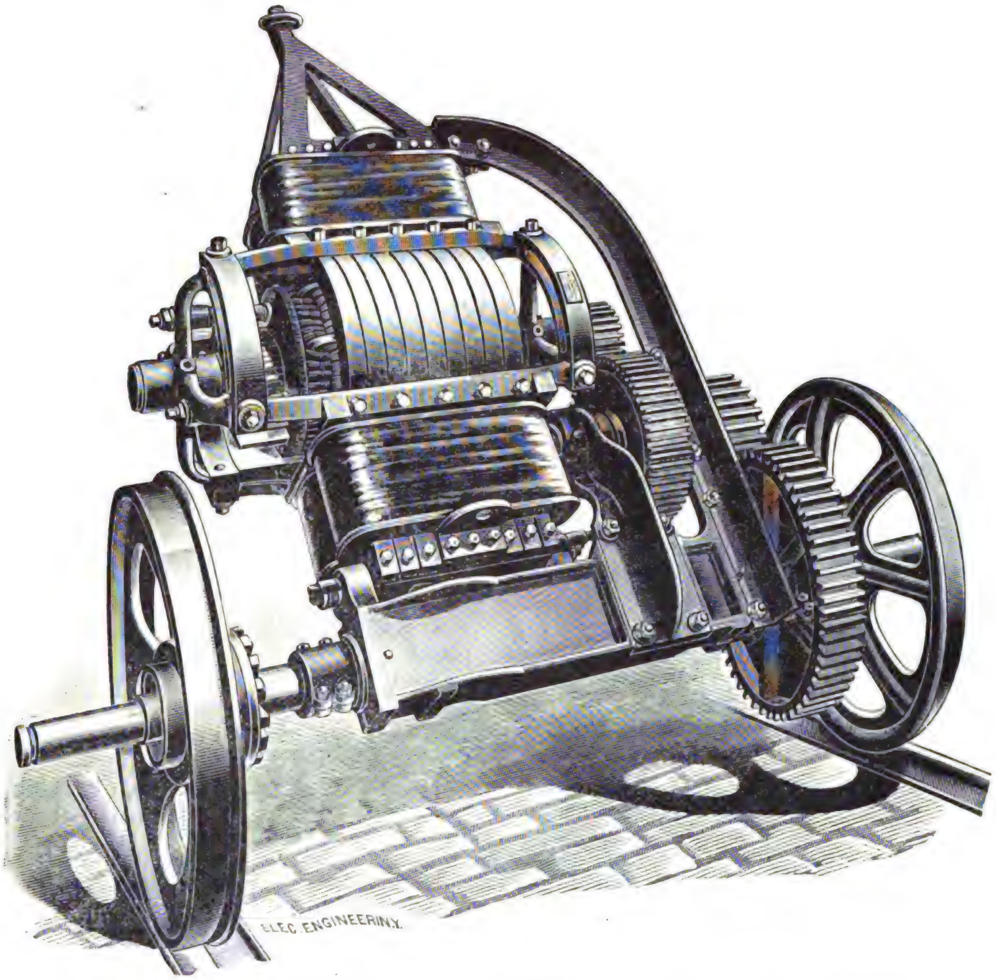


FIG. 1.—NEW STREET RAILWAY MOTOR OF THE UNITED ELECTRIC TRACTION CO.

The bronze spider at one end of the armature shaft, with the two brush holders in position, is shown in Fig. 5. It will be noticed that these brush holders are adjustable in three different directions and that their mechanical action is exceedingly simple and certain. The brushes used are of carbon, a special variety of carbon composition having been found, after a long course of experiment, to best suit the requirements of railway motors. This compound has been patented by the United Electric Traction Co. The brush holders are made of rich brass and are very strongly and securely attached to the spider.

POLARIZING CONDITIONS IN A GALVANIC BATTERY.

PROF. A. E. DOLBEAR.

When hydrogen accumulates upon one of the plates of a galvanic battery so as to reduce the current, the cell is said to be polarized, and various methods have been devised to prevent this, some chemical, as in two fluid cells, and some physical, as when the plate is rotated, and these are called depolarizers; the idea being that the polarization itself consists simply in the accumulation of gas upon the plate. I do not know that any attempt has been made to explain the underlying conditions present where chemical action is present or latent in a battery, which bring about such a result, for it is plain that such a result must have some antecedent physical conditions that determine it.

The following explanation has seemed to me to be probable, and the commendations of a number of my electrical friends induce me to publish it, not as proved, but as a step towards a clearer understanding of the mechanical conditions present in a galvanic battery.

When a piece of zinc is immersed in water it is found to be electrified, and its potential may be measured by a suitable electrometer.

Now, we know from purely chemical sources that there is chemism, or chemical attraction, existing between zinc and oxygen, and that under favorable conditions zinc will be oxidized. This so-called affinity of zinc and oxygen is not suddenly created by their juxtaposition under certain circumstances, but exists all the time, only waiting for an opportunity to show itself.

What then are the real conditions present when a piece of zinc is immersed in water? The zinc is a solid, the molecules cohere, and there is a certain degree of rigidity to the molecules. With the water it is different. As a fluid, the molecules are free to move about among each other with but little internal friction. As the molecule of water is made up of both oxygen and hydrogen, it may have an oxygen side and a hydrogen side, in which case, if there be any selective agency acting more upon the oxygen part of the molecule than upon its hydrogen part, and if the molecule as a whole is capable of shifting its position easily by a simple rotation upon any axis, as is true in this case, then all the molecules of the water that come in contact with the zinc must be oriented by the zinc so that the oxygen side of the molecule faces the zinc at every point, and consequently the hydrogen side is away from it. This would be a true polarization of the molecules of water, and the distance to which it would extend would depend upon the strength of the chemism between the two acting elements. Such a chemical field might extend indefinitely.

When a piece of carbon or copper or other element is placed in water, it exhibits similar electrical property, but different in degree from that of zinc; so similar polarization of molecules would be set up about it. The difference in the degree of chemism between the two elements and the oxygen of the water would determine the rate of oxidation under given conditions, and this difference we call the electromotive force of the cell. Also, the mere fact that there was a difference in this particular between the two immersed elements would tend to produce between them a similar condition of arranged or polarized molecules.

All this might be expected to occur, whether there was a chemical reaction or not, that is to say, whether or not the zinc was dissolved and water decomposed. Whether this happens, or not, depends upon the degree of tension represented by the difference in the so-called chemism between the two elements, which difference we measure in volts, and needs to be about 1.5 for water.

If other solutions than water be used, the same mechanical conditions and arrangements would be present, differing from it only in degree.

The substance of the idea is this, that the chemism existing between the zinc and the element oxygen in the water *compels* the molecules of the water to turn so as to present their oxygen side to the zinc, which they are able to do freely, because such movements are not subject to appreciable friction in the liquid.

When the other battery element cannot combine with oxygen in any degree under the existing conditions, as when carbon or platinum is used, then only hydrogen will be set free, as there is a greater stress for the oxygen at the other element and there must be an exchange of partners among the molecules along the whole line between the elements, according to Grotthüs' hypothesis; so that, underlying the accummulation of hydrogen called polarization, is a real polarization in which all the molecules are facing one way from the mechanical necessities present.

It seems not unlikely that this condition of things in a heating liquid might be observed by noting the effect produced by it upon a beam of light transmitted through the liquid, especially upon reversal of electrical condition.

THE HISTORY OF ELECTRIC TANNING.

In a recent article in *La Lumière Electrique*, M. Rigaut says: "Like all other discoveries and inventions, that of using electricity in tanning is not a new one. About 1850, a currier named Crosse, invented an apparatus to utilize what he called the 'effects of electricity or galvanism for tanning purposes.' Two electrodes were placed in a tan-pit, one made of lead, the other of zinc. The pit was then filled with water and skins, and, after an interval of three days, tan was added in small proportions, in order to concentrate the liquor. Ten years later, an Englishman named Ward, of Lancashire, made a series of experiments. Instead of electrolyzing the skins in water before adding the tan, he used electricity in the tanning baths. At Paris, in 1861, a M. Rebu invented a system of electric tannage. This is said to have been very complicated. The skins were treated with carbonic acid and hydraulic pressure, and then submitted to the action of salts of lime, of magnesia, and of iron. Currents of electricity were passed through the skins while they were immersed in the above mixtures and the usual tanning solutions. In 1874, M. de Mertens tried another system. At the bottom of a large vat was placed a layer of carbon, connected with the positive pole of a dynamo. On this skins covered with tan were placed. On the top of this heap a plate of zinc was placed, connected to the negative pole. The vat being filled with tanning liquid, the current was passed through. M. Mertens' system has been employed in nearly 600 pits for some years past at a tanyard in the environs of St. Petersburg, and by it about thirty-five days is required to tan the skins. In 1876, Gaulard and Kresser brought out another process, and in 1883, skins tanned by Gaulard's process were exhibited in England. In 1887, in Sweden, Messrs. Abom and Landin brought out a method for the use of electricity, and this has been in operation for two years at Noorköping, in Sweden, with good results, forty-five days being required for tanning. Some months before this Messrs. Worms and Balé, at Paris, had worked a process for the rapid tanning of skins by the aid of the electric current.

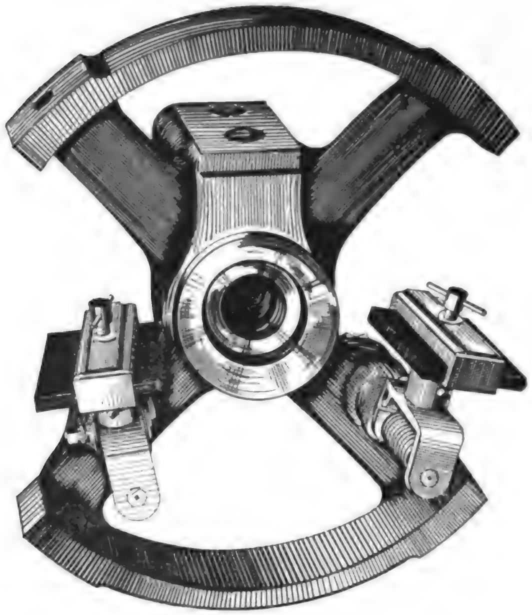


Fig. 5.—Armature Bearing and Brush Holder.

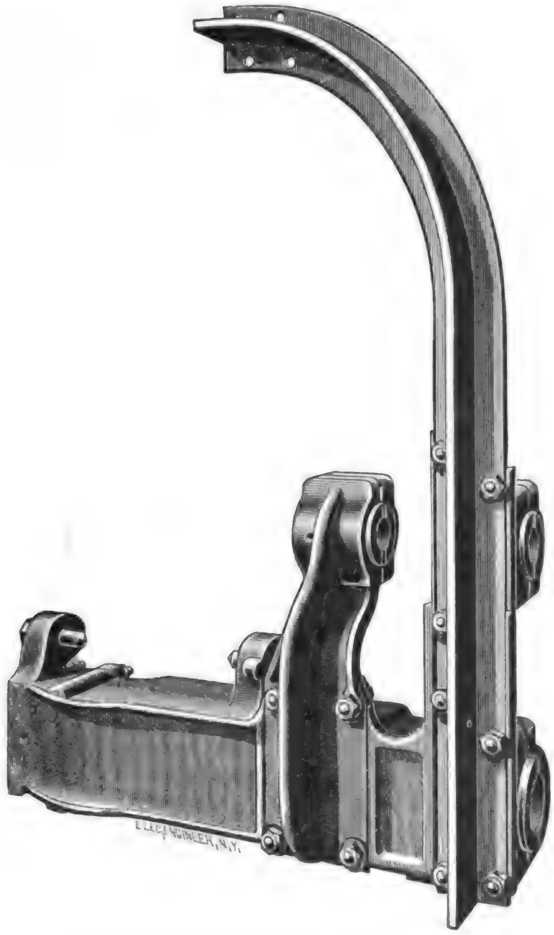


Fig. 4.—Lower View of End Casting.

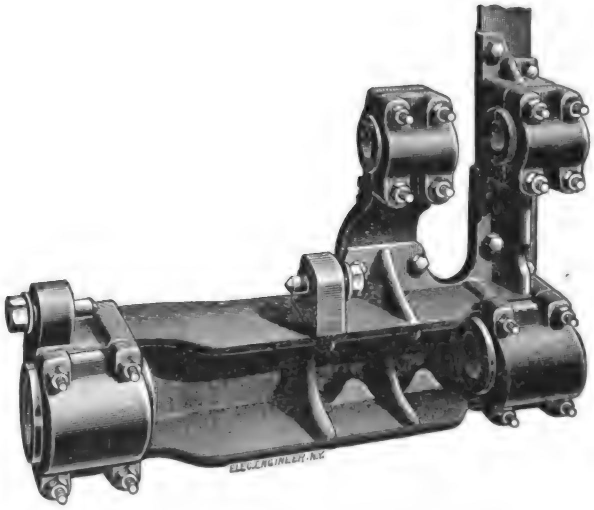


Fig. 3.—Upper View of End Casting.

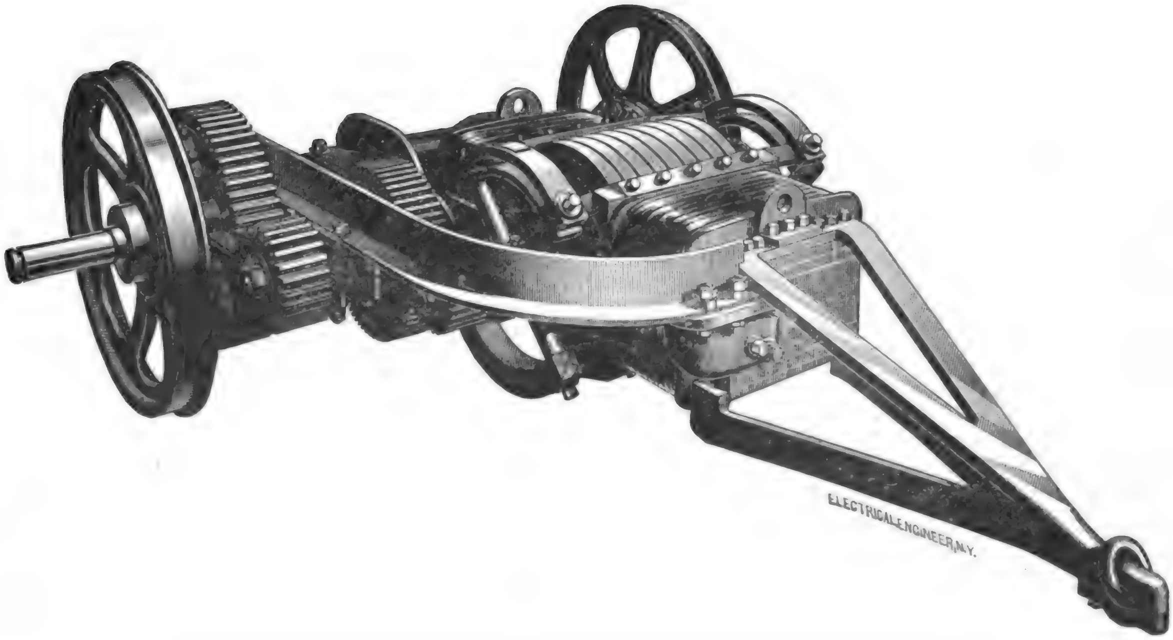
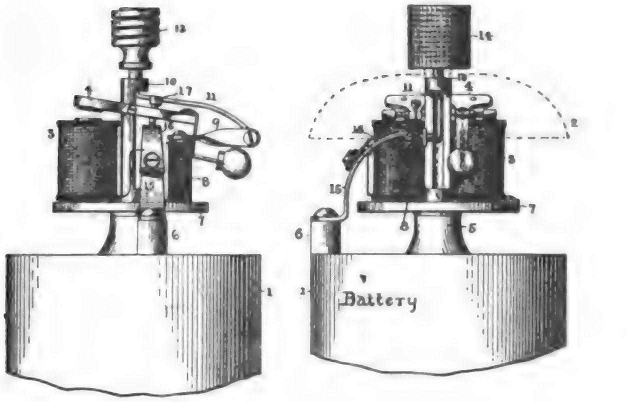


Fig. 2.—New Street Railway Motor of The United Electric Traction Co.

A NOVEL PORTABLE ELECTRIC FIRE ALARM.

There are many instances where it is desirable to provide means for giving a local fire-alarm in buildings which are not wired and connected to the engine-stations or fire-department of a city, as when a building is used temporarily for storage or like purposes, or in buildings outside of the fire-department limits. In addition to this the manufacture of many articles involves the application of heat, as, for instance, in drying rooms where a certain temperature must not be exceeded. For these and similar purposes a portable electric alarm can be most conveniently applied, and with that object in view, Messrs. F. R. Upton and F. J. Dibble have recently devised and patented a compact arrangement. The apparatus consists broadly of a battery with a bell or buzzer, normally on open circuit, and a thermostat for closing the circuit when the temperature exceeds a given limit.

The accompanying engravings show the arrangement of the combined bell, thermostat and battery. As will be seen, the bell-dome is supported on the dry battery which is here employed. The insulating post 8 carries an arm which terminates in an adjustable contact. Through the upper part of the post 10 extends an angle-rod terminating in a contact 12. The upper end of this angle-rod is rigidly connected to one end of a thermostatic coil 13, which is composed of two metals of unequal expansibility. The other end of the coil is connected to a stationary part of the apparatus. Around this thermostatic coil there is placed a shield composed of perforated sheet metal or wire fabric for protecting the coil from mechanical injury. From the other electrode of the battery rises an arm 15, the end of which carries an electrical contact, which in the normal condition of the apparatus is in contact with a terminal carried by spring 16, insulated from the arm as shown. This spring is weaker than the retracting-spring of the armature and is held compressed by means of the retracting-spring through an adjustable screw which terminates



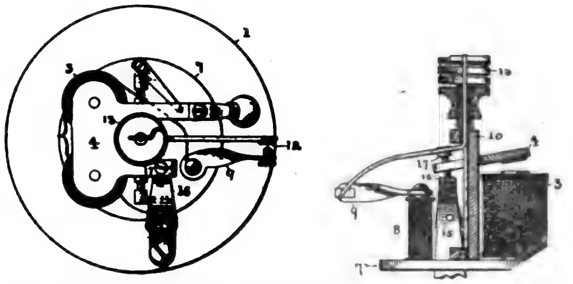
Figs. 1 and 2.—Portable Thermostatic Alarm.

in an insulating-point. Spring 16 is connected by a wire through the magnet to arm 9.

In using the alarm, the contact in arm 9 is adjusted to a certain distance from contact 12, the distance depending upon the degree of heat at which it is desired to sound the alarm. This adjustment can be made when the bell dome is in position. The apparatus having been adjusted, is placed in the room to be protected. As the temperature rises the thermostatic coil will be affected in such manner as to throw the angle-lever and its contact 12 toward the contact on arm 9, and when the limit of temperature is reached for which the apparatus is adjusted the contacts will come together and will close the circuit. This closure of the circuit energizes the magnet and attracts its armature, bringing the bell-hammer against the bell-dome. At the same time it raises the screw 17 from spring 16, allowing the spring to rise and break the circuit. As soon as this occurs the retracting-spring draws the armature back to its original position, thus again closing the circuit between 15 and 16, which again energizes the magnet. It will be seen that the contacts on 15 and 16 cause the bell to act as a vibrating bell in the well-known manner. With this arrangement the alarm continues to sound as long as the temperature remains high enough to keep the circuit closed between arms 9 and 11.

An ordinary dry battery is found to furnish sufficient current, to require practically no attention and to last for a long period of time. Moreover, with this form of battery, all danger of leakage of liquid or spilling the same by breakage of the jar is obviated; but evidently other forms of battery would serve the purpose.

By the construction described several important advantages are gained. In the first place, the thermostatic coil



Figs. 3 and 4.—Portable Thermostatic Alarm.

or device is raised away from the mass of the battery and other apparatus. It will therefore be much more sensitive to the influence of heat in the room where it is placed, since it will be affected at once and will not be dependent on the temperature of the supporting mass. By placing the bell-dome as shown, the circuit contacts and springs are protected from mechanical injury and to a very large degree from dust, which otherwise would settle upon them.

THE ROBINSON RADIAL CAR SYSTEM.

One of the features that was early brought out in the application of electricity to street railway work was the enormous amount of power that the cars with the ordinary trucks and four-wheel base consumed in going around curves. The present writer has witnessed scores of runs when the needle of the ammeter would jump forward in "blocks of five," ten and twenty amperes at a time, showing how great was the draft at such periods on the source of current. Where storage cells have been used, the frequent inability of the cells to last has been due to the drain and strain on them necessitated by the effort of the motors to overcome the sudden and tremendous increase of friction. Evidently something had to be done to bring the jogging and jolting horse car up to a point of efficiency at which there could be some realization of the hopes and convictions entertained as to the superior economy of electricity. So long as the abnormal, terrific strain fell upon the horse, nobody seemed to care much; but when the wringing of withers and the exhaustion of vitals was transferred from animals to mechanism, the shameful cruelty and barbarism of the whole thing became apparent. The result is that within the last year or two cynical indifference on a very important subject has been succeeded by the most lively interest, and no questions to-day are more closely studied than those which relate to smoothness of running and economical operation of the car gear.

Among the first to attack the problems involved in the condition of affairs thus exposed was Mr. Robinson, of Boston, well known in electrical and railroad circles as the inventor of the system of electrical signals for railways now owned by the Union Switch and Signal Co. It was natural that this gentleman should be attracted to the

subject. His earlier work had required the use of the rails of the tracks as conductors for the current; and we believe that the method now in universal use on electric railways of connecting the rails together by means of wires was his invention. In the department of work now under consideration, Mr. Robinson went straight for a correction of the troubles and losses due to getting around curves. Fig. 1 represents a truck or street car of ordinary construction with rigidly parallel axles, showing how it gets around a curve in the direction of the arrow. When the wheel, A, strikes the curved rail, the rail resists the shock and causes the wheel to rebound or glance; at the same instant the propelling power gives a forward impetus to the truck or car, when the wheel again strikes the rail with great force and again rebounds. The course which the wheel travels is indicated by the saw-tooth line, H, in the accompanying cut. Thus the truck or street car finally gets around the curve, if at all—not by rolling, in accordance with mechanical principles—but by a succession of blows or jerks, commonly called "grinding;" it is skidded around by main force.

When the "horse car" is propelled by electricity the grinding on curves is exaggerated; the wheels, which strike the rails at an angle, tend to mount them at every instant, and frequently do so; the motor car often gets stalled on sharp curves, especially in towing another car, and in order that it may get around street corners at all, the curved rails are kept liberally daubed with grease. The horse car has its two axles placed near together and near to the centre of the car, otherwise it could not get around the street corners at all. These axles act as fulcrums on which the car body has an end tilting and rocking motion extremely disagreeable to passengers, and which frequently throws the car off the track. This construction furthermore makes a high rate of speed, with safety, impossible—even on a straight track.

In order to remedy this, Mr. Robinson has devised and adopted a six-wheel radial truck. Fig. 2 illustrates the position which the axles and wheels of such a truck assume in running over the curve track, B. The axles automatically assume an exactly radial position on any curve upon which the car runs, and the power required to propel this car around curves is little, if any, more than that required to propel it on a straight line. The radiation of the axles diminishes the power required to propel cars around street corners from fifty to seventy-five per cent., it is said, and often more than this, and also makes it possible to roll cars around street corners easily which, without the radial axles, could not, by any possibility, be got around such curves, on the rails, however much power might be applied.

The "grinding" on curves, inseparable from all car trucks with rigidly parallel axles, that is, all now in use, is obviated in the electric "Radial" car. In this car each axle is always at right angles to the line of travel, whether on a straight line or on a curve; that is, the axles automatically, but positively, adjust themselves to the changes in the direction of the line of travel; they are always parallel on a straight track and radial on curves.

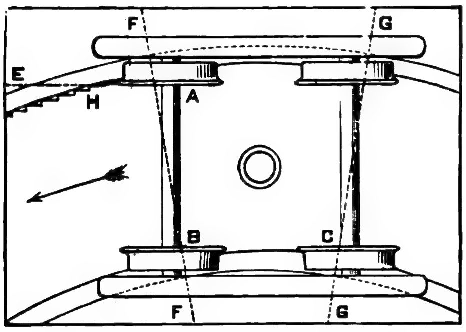


FIG. 1.—RIGID TRUCK ON CURVE.

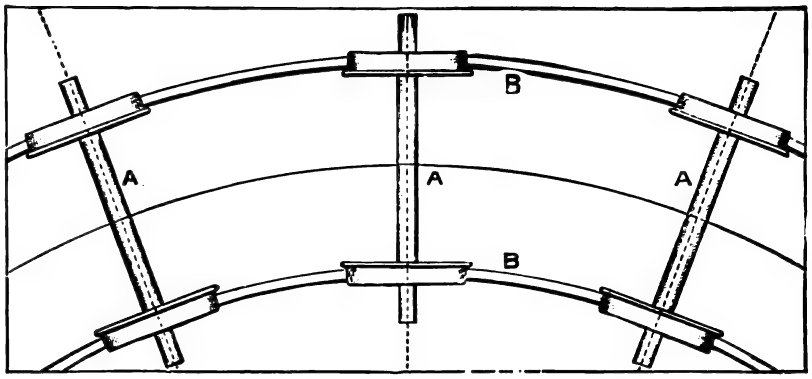


FIG. 2. RADIAL TRUCK ON CURVE.

In Fig. 3 we show clearly the construction and appearance of one of the Robinson "Radial" steel trucks for electric roads. As will be seen, there are three axles and six wheels, two of the axles carrying motors and four of the wheels being drivers. The truck here shown has been running under a closed car in the regular electric service of the West End road since June 1, 1890. Each axle carries a 15 h. p. Thomson-Houston Motor. The dimensions of the car are as follows: Length over all, 36 feet, 4 inches; length of body, 28 feet; wheel base, 15 feet; seating capacity, 42 passengers; carrying capacity, including standing room, 150. Fig. 4 shows another closed car of the same type, but of slightly smaller dimensions, which has been running since last December. Fig. 5 is an engraving of the Robinson "Radial" open car. It has twelve benches and seats 60 passengers. It is 34 feet, 3 inches long over all; has a 14 feet wheel base, and its steel truck is provided with two 15 h. p. Thomson-Houston motors. It has been running on the West End road in regular service between Arlington and Bowdoin Square since July 12. Fourteen

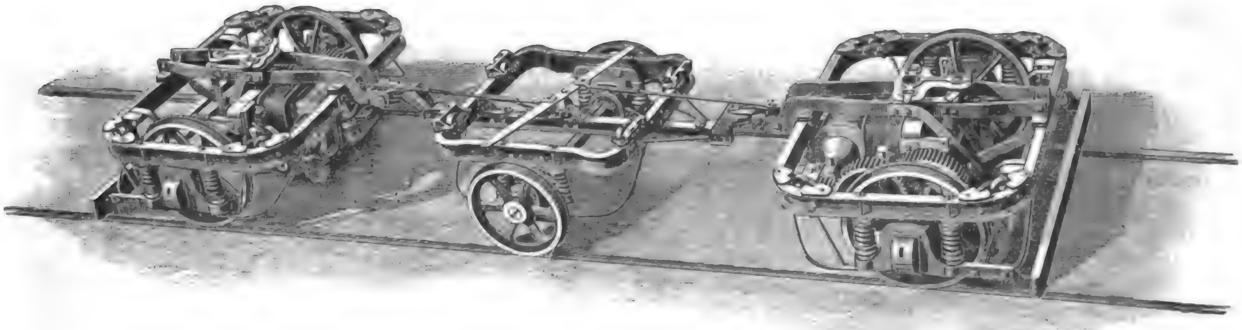


FIG. 3.—THE ROBINSON RADIAL ELECTRIC CAR TRUCK.

other closed cars are now being built for the West End road and are nearly ready. A new Robinson car of magnificent proportions has recently been supplied to the Eckington & Soldiers' Home Railway Co., at Washington. It exemplifies strikingly the luxury that is to prevail under the new regime of electric power. It is a closed car and seats 40 passengers. The interior is furnished in rich mahogany with gold panels. On the inside it has a sweeping arch roof similar to the design of the latest steam cars. Above this is a monitor top not seen from the inside. A number of ventilators in the ceiling communicate with the monitor top and through it with the exterior air, giving excellent ventilation without any draught.

In conclusion it should be stated that it has lately been shown by special tests made under competent authorities that, in addition to better running on curves and grades, these trucks have been found to take less power in straight-away running than do eight wheeled cars of the same weight and load. We have seen the figures of the report, which bear out this assertion, but as they are "confidential" and the private property of the company for whom the tests were made, we are not at liberty to publish them. The patents on the truck, etc., are owned by the Robinson Radial Car Truck Co., of Boston, which is the parent organization; and the active work of supply and construction is carried on by the Robinson Electric Truck and Supply Co., of Boston.

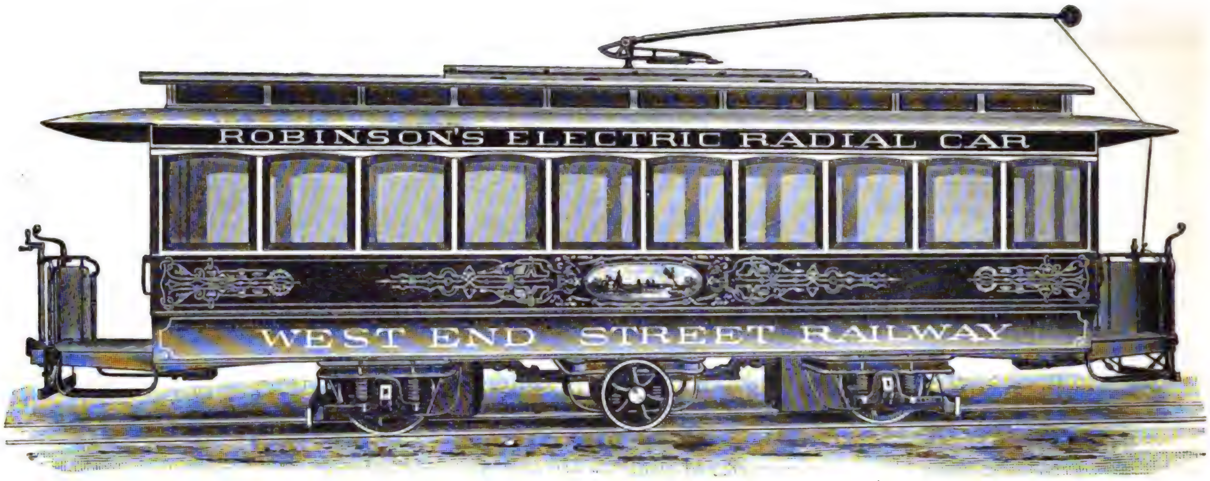


FIG. 4.—CLOSED CAR WITH ROBINSON RADIAL TRUCK.

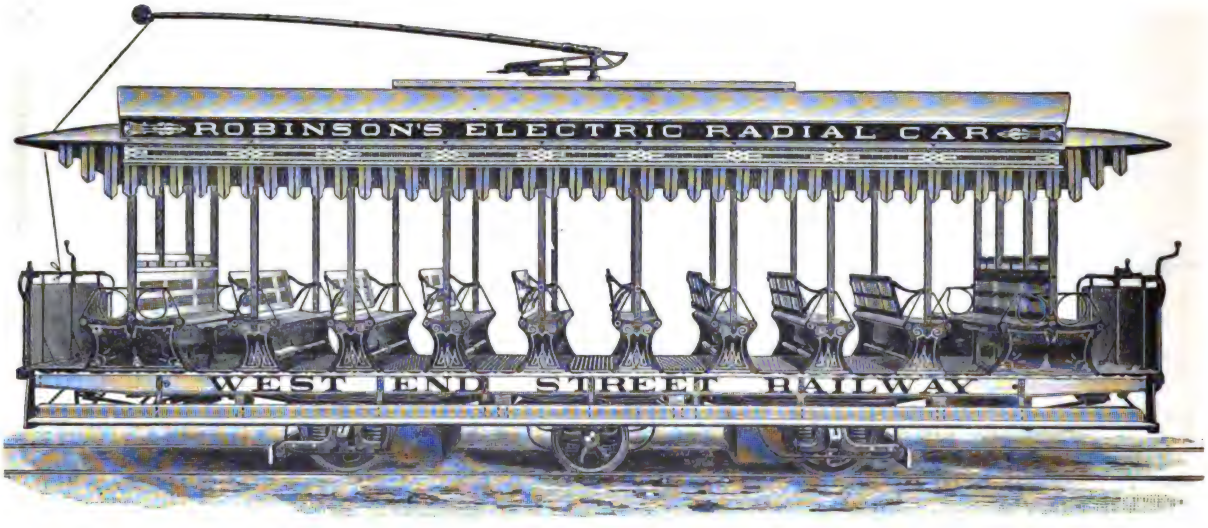


FIG. 5.—OPEN CAR WITH ROBINSON RADIAL TRUCK.

EICKEMEYER WINDING FOR ELECTRIC RAILWAY MOTOR ARMATURES.

A NEW departure has recently been made by the Edison General Electric Co. in its electric railway work by the introduction upon its motors of the Eickemeyer method of armature winding, whose use it controls in that class of work. As our readers are aware, the armatures of electric railway motors have generally been wound upon the Siemens system, the main objection to which is that the irregular mass of wire at the end has a tendency to move, abrading the insulation and leading to a short circuit. As the burn-out most frequently occurs in the under or inner coils, repairs are unduly expensive.

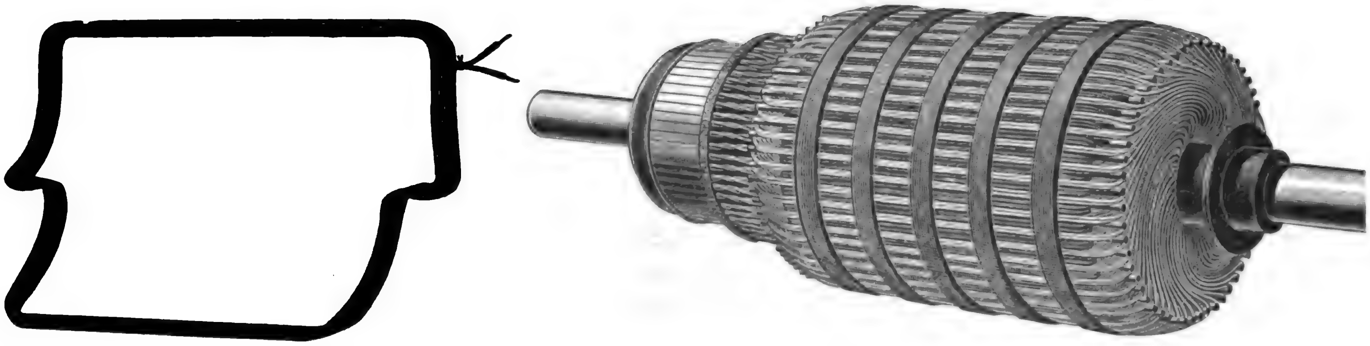
In the Eickemeyer system of winding, each armature coil, Fig. 1, is wound upon a form of peculiar construction, and comes out standard and interchangeable in every respect. In building an armature originally, the laminated iron core is first prepared as in the Siemens armature, and upon this are loosely placed the necessary number of standard coils, which are locked in place around the armature by means of the wooden pegs, shown in Fig. 2. The result is, a square end both front and rear, instead of the cone-shaped end of the Siemens armature. The coils are held firmly in place, with absolutely no chance for motion, and there is no mechanical pressure from coil to coil which would tend to cause short circuit. The armatures are necessarily of standard diameter and interchangeable, and it is claimed

that the Eickemeyer armature will never burn out except from dead over-load causing melting of the wire, from accidental mechanical injuries, or from short circuit due to outside causes. If, however, an armature coil should burn out from any of the causes mentioned, it could be replaced without difficulty by any ordinary mechanic and without return to the factory, the whole operation consuming about a day's time and a small amount of material. The local railway company would be provided with a sufficient number of standard coils held in reserve.

The temperature is regulated by the arrangement shown, which constitutes a governor, set in operation and acting through the expansion of the oil, and the action of which is to automatically shunt the heating current around the resistance within the heater.

C. & C. MOTOR COMBINED WITH VENTILATING FAN.

We illustrate on this page a combination of the C. & C. motor with the Blackman ventilating fan. The plant from which the engraving is made was installed not long



Figs. 1 and 2.—New Edison Electric Railway Armature and Coil.

since in the Union Trust Company's building on Broadway. It is made up of a 30-inch disc exhaust fan and electric motor mounted directly on the shaft and supported by the fan brackets. It revolves at a speed of 600 revolutions and delivers 20,000 cubic feet of air per minute. A large demand has arisen for machines of this character as being preferable to the equipment in which the motor is belted to a pulley on the fan, causing a certain amount of

C. & C. Motor and Ventilator Combined.

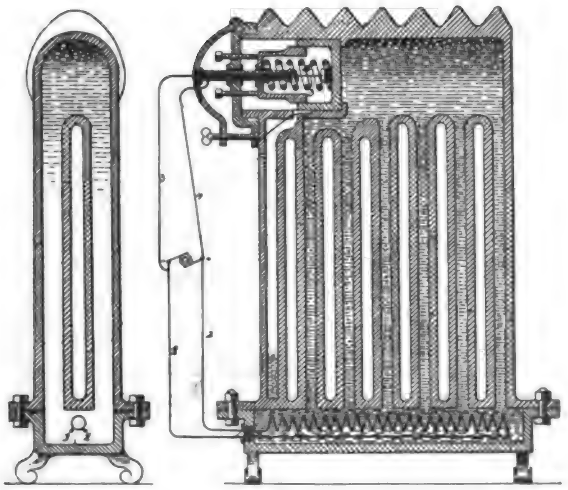
noise and dirt. The arrangement is very easily installed, and may be placed in any position without regard to belting or shafting. The combination is also superior in the qualities of compactness of form, and it in no wise obstructs the draught of air set up. In view of the numerous places of public resort and gathering where ventilation is bad, it is eminently to be desired that arrangements of this kind should be more generally installed. Their utility will be apparent at once.

Fig. 2 shows the peculiar curvature of the coils at the rear. The same curvature is found at the front end. The whole armature is perfectly ventilated, particularly at the front, where difficulty has frequently occurred. It is the strong belief of the Edison Company that one of the most serious difficulties that has been met with in electric railway work is entirely overcome by this new type of armature they are now manufacturing and using.

ABSHAGEN'S ELECTRIC HEATER.

Now that the possibilities of electric heating are becoming more and more apparent, a variety of apparatus is being designed to carry out the method. Among the more recent of these is that due to Mr. Ernest Abshagen, of Chicago, which is illustrated in the accompanying engraving.

Mr. Abshagen employs, as the material to be heated, a



Abshagen's Electric Heater.

non-conducting fluid, such as whale, linseed, or cotton oil. The oil evidently is brought into immediate contact with the heated wire, whether hot or cold. The use of oil also allows a high temperature to be employed. Whale oil, for instance, boils at a temperature of 650 degrees Fahrenheit. As no steam or vapor is generated below that point, no precautions against internal pressure are necessary.

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Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.
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VOL. X. NEW YORK, OCTOBER 1, 1890. No. 126

The discoveries of physical science are a part of the nation's strength and glory. The inventions of mechanical skill are, or ought to be, the poor man's boon and blessing.—Professor Sedgwick.

ELECTRICAL ENGINEERING AT THE WORLD'S FAIR.

AT the Philadelphia Centennial Exposition of 1876, there were 9,857,625 visitors; at the Chicago Columbian Fair, if recent European precedent is to be accepted, there should be three or four times as many. Let us say that 25,000,000 entrances will be registered at the turnstiles. What is to be the leading impression carried away by that vast aggregate of people? What fact do electrical engineers wish most to be imprinted in their memories and to influence them in daily life?

Fourteen years ago, the part played by electricity at Philadelphia was insignificant. It was not even mentioned among the dramatis personæ of that great and stirring spectacle. General Walker in his masterly review of the subject does not touch on electricity. There was, in truth, little material to work up, and he could not make bricks without straw. American skill in the invention and production of agricultural implements, small arms, sewing machines, scales, locks, wood working machinery, carriages, cars, engines, and the like, was amply displayed; but the exhibit of electrical handicraft created no sensation, and the electricians were but a handful. Still, as if to show how great and incalculable were the latent possibilities of electricity, it was there that the world first listened to the faint tremulous whisper of the telephone.

Now, in what way are we to distinguish at Chicago the coming into activity since that time of a group of industries that, together with the older one of telegraphy, employ more than 250,000 souls and count up an investment of $600,000,000, of which by far the larger part has been massed together during the last ten years? The answer to this, in our opinion, is that the single attempt should be to enforce the truth by ocular demonstration that electricity is the one supremely successful modern agency for distributing light and power. The opportunity is the grandest that electrical engineering has yet had, and it must be utilized to the fullest extent. No doubt there will be other important new electrical inventions before the Fair opens, but the triumphs of electric light and power, with their allies in electric heating and electric metal working, must be brought forward so thoroughly that never after can there be popular ignorance or a lack of popular appreciation.

The late Centennial at Paris exemplified what could be done with the aid of the electric light in opening Expositions by night. The attempt was brilliantly successful and settled the question for the Fair in this country, whereever held. When the extent of the buildings and grounds at Chicago is definitely known, some estimate may be formed of the lamps required. It is not unlikely that anywhere from 50,000 to 100,000 incandescents can be used to advantage in interiors, with a countless number for "structural" and decorative effects. For the grounds and larger spaces perhaps 2,500 arcs would suffice.

But this only represents a steam and electrical plant of from 7,500 to 10,000 h. p., an everyday matter in modern work on light and power stations of the new class. The more marked display of electrical engineering will evidently occur in connection with the electric power service. The public is still quite unfamiliar with the versatility of the electric motor and the economic efficiency of electric power distribution. Instead of grouping all the moving apparatus, therefore, in a heterogeneous, confused collection under one big roof, dependent on a few long, heavy lines of shafting, every exhibit to be driven can be located just where it belongs geographically, industrially, or in any division that State or politico-economic considerations may require. The advantages of this in an educational sense it is needless to dwell upon. The World's Fair will thus come nearer what theory supposes it to be, as a kindergarten of the nations.

Other suggestions involving the use of electric power naturally arise. One might look for concrete examples of long distance power transmission, illustrative of what can be done in utilizing a little more than the present one per cent. of our 200,000,000 h. p. running away in our falls and streams. Then the question reasonably comes up whether electricity shall be used not only in transporting people about the grounds, but in the heavy service between the two sections miles apart.

In other words, taking it generally and broadly, the proposition we have made is that electricity shall be the active motive power of the whole Columbian World's Fair. The plan has possibly been hinted at before, but we have now taken the trouble to point out some of the conditions it involves and to open up the glorious opportunities for the very best electrical engineering skill and inventive genius of the country. We wish to point out further that the plan looks necessarily to the concentration of the steam plant and current generating apparatus in one grand station, probably by the side of the Lake, where the most advanced types of American engines and boilers can be put most perfectly in operation. Evidently the steam equip-

ment for such service as we have outlined would be of a colossal nature, but it would all be bunched, and would be easy to handle as well as cheap to run. From the dynamos, of a magnitude corresponding to that of the engines, current would be carried in a variety of ways to motors of every shape, class and size, and every motor inventor and builder could take, or be allotted, the work best suited to his machine.

We venture to offer these suggestions the more readily because Mr. Gardiner C. Sims is the chairman of the World's Fair Commission Committee on Electricity and Electrical Appliances. As a distinguished and representative engine builder and steam engineer, he may safely be trusted to look to the welfare of his own profession. As one of the warmest friends and advocates of electrical development, he may equally be relied upon to see, with quick intuition, how much is to be gained by the two great industries that so strikingly in this country have gone on to perfection hand in hand together, and that have every interest in common. He may also be depended upon to gather around him the ripest skill, ability and experience that can be secured for the undertaking.

DOLBEAR ON POLARIZATION THEORIES.

The action going on in electrolysis was one which early attracted the attention of electrical scientists, and numberless theories have in the past been promulgated to explain the phenomena involved. Even now the subject still attracts attention, and deservedly so, as a clear comprehension of this particular action cannot fail to aid in the comprehension of others closely allied to it. Prof. Dolbear, whose ability as an instructor and teacher of electrical science is recognized, gives elsewhere an interesting explanation of the phenomena of polarization, in which he embraces not merely the action of the gas generated, but also takes into account a peculiar condition of the electrodes. He bases his arguments upon observed phenomena, and his ideas cannot fail to assist in clearing up a subject of much importance.

ELECTRICITY IN WARFARE.

The introduction of the electric light on board ships and especially on war vessels, with a full equipment of generators, has naturally afforded an opportunity for the introduction of other electrical devices, notable among which are electric motors for ventilation, for the training of guns, for the hoisting of shot, etc. But a new departure has recently been taken in the application of electricity to warlike purposes in the introduction of range finders depending upon a few simple principles, among which that of the Wheatstone bridge is prominent. The public is already familiar with some forms of Lieut. Fiske's range finders, which he has recently, however, simplified to a considerable extent, so much so, that the readings can now be taken direct from a graduated dial. The description in this issue of Lieut. Fiske's new range finder, shows it to be a neat application of the modified Wheatstone bridge principle, and not the least notable point in connection with it is, that the errors due to the variation of the conditions from actual theory are compensated for by the very construction of the apparatus. With all these refinements and means placed at the service of the commander of a modern war vessel, it is indeed problematical whether the carrying on of warfare would be a pleasant undertaking in the future, considering the enhanced probability of a shot taking effect. The fact may also be noted here that the U. S. S. "Baltimore" is probably the first naval vessel in which a telephone service has been established so as to enable the commander to communicate from the conning tower with the various parts of the ship.

TELEPHONIC SPECIFIC INDUCTIVE CAPACITY.

The necessarily enforced burying of many telephone wires in our cities cannot fail to affect the clearness of telephone transmission within cities, and in extra-territorial work where numerous stretches of cable are inserted at river crossings, etc., the effects are being more and more felt. This trouble becomes evident when we consider that the readiness with which a line transmits speech is dependent both upon the resistance and upon the capacity of the line, and further that while the aerial line has an average capacity of 1/100 of a microfarad, the average telephone cable has a capacity of about 1/5 of a microfarad. In other words, a single mile of cable is equivalent in this respect to 20 miles of overhead wire. This point is particularly dwelt upon by Dr. William W. Jacques, who points out in another column the necessity for keeping down as low as possible the specific inductive capacity of telephone cables, and shows that considerable difference exists among the various insulators in this respect. He also draws attention to the fact that a distinction must be made between the telegraphic specific inductive capacity of a cable or its capacity at slow rates of charge and discharge, and its telephonic specific inductive capacity, that is, its capacity at high rates of charge and discharge, and that in order to obtain accurate results in telephone work these measurements ought to be made on the latter plan. Attention is also drawn to the necessity of avoiding the presence of moisture, not only on account of its lowering effect on the insulation, but also on account of its high specific inductive capacity, which increases the difficulty of transmission through such cables. Dr. Jacques' article is worthy of careful reading.

New Electric Railway Construction.

The description which we give in another column of the new railway motor of the United Electric Traction Company is an indication of one of the principal directions in which modern practice of railway construction is apparently drifting. The almost universal employment of two motors mounted on either axle of a car, although possessing advantages in many ways, is nevertheless open to some objections which are not encountered with the use of a single motor. This is being recognized, and will no doubt result in a more general employment in the future of single motor trucks equipped with power equivalent to that of the two now employed. The construction shown on another page at once admits of a reduction in the number of gears and bearings, and affords a flexibility between the two axles which must be of considerable advantage when sharp curves are encountered.

AUTOMATIC REGULATION OF ACCUMULATOR CURRENTS.

One of the principal difficulties attending the use of accumulators in general electric lighting work, particularly in connection with their application as auxiliaries to direct lighting plants, is due to the characteristic rise and fall of their potential during charge and discharge, respectively. Even were it practicable, which ordinarily it is not, to charge a battery by means of a special dynamo to be after wards discharged on an independent working circuit, the reduction in pressure within the limits of its working capacity would still be marked. When, however, as is usually the condition in practice, the battery must be charged by a dynamo simultaneously furnishing current to lamps, the difference between the potential at the end of charge and at the end of discharge must be taken into consideration.

Various methods of compensating for these variations, so as to maintain an approximately uniform pressure at the lamp terminals independently of the potential of the battery as a whole, have been devised, such as manual switches for increasing or diminishing the number of active cells, and others for inserting and removing from the working circuit, as required, more or less dead or active resistance, in the form of wire or counter-electromotive force cells. Automatic apparatus for accomplishing the same end has also been introduced with more or less success, both in this country and abroad, but most of it has been somewhat cumbersome and expensive.

With the object of producing an entirely automatic pressure regulator for storage battery lighting plants, which would be free as much as possible from the objections above cited, Mr. Geo. B. Prescott, Jr., has devised and recently patented the method of regulation shown diagrammatically in the accompanying illustration.

Before proceeding to a description of this invention, it will not be out of place to refer to the results to be effected. Primarily, what is required according to the load, is a current in the working circuit, either from the dynamo alone, from both the dynamo and battery, or from the battery alone when the dynamo ceases to run. At times when the consumption of current in the working circuit will admit, the battery must be charged with the surplus current from the dynamo, and during all these various conditions and the changes accompanying them the potential of the lamp circuit must remain fairly constant.

Almost every governing device depends for its action on the variation of the force to be regulated. In this instance it is the potential at the lamp terminals that is to be governed; hence, it is evident that it must vary in some degree before the apparatus can act, and the amount will, of course, depend, as in all similar cases, upon the sensitiveness of the apparatus employed.

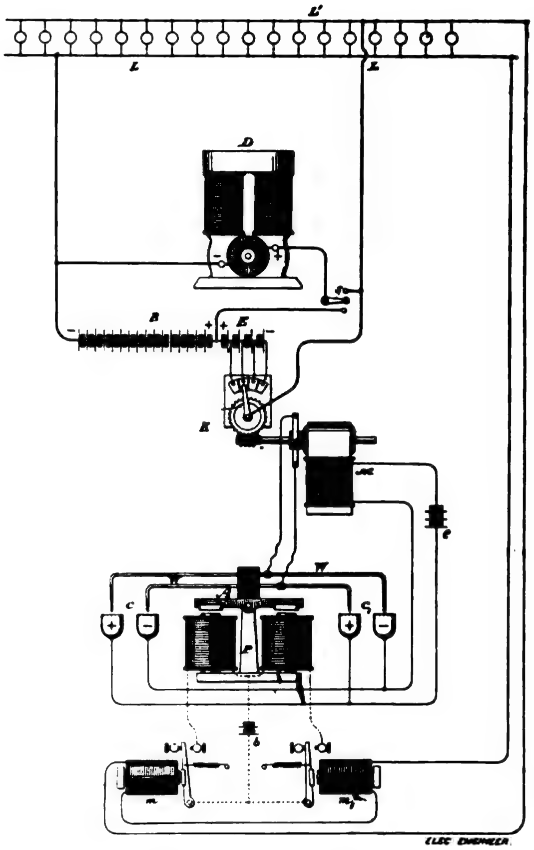
Any delicate potential indicator, if suitably connected, will respond to variations in pressure in the lamp mains, the resulting deflection being in one direction, or the opposite, as the variation is above, or below, normal.

If this movement of the indicator could be made sufficiently powerful, it might be utilized to perform directly the mechanical work, such as adding or removing resistance, necessary to restore the normal potential. The required sensitiveness of the indicating device forbids this, however, and although it may have sufficient force to exert the trifling power required to complete or sever a milliampere circuit, the ordinary devices have so far proved unsatisfactory when used in connection with storage batteries.

The essential features of Mr. Prescott's arrangement is the substitution of two ordinary telegraph relays wound to high resistance, for the various forms of instruments usually employed for similar purposes. By magnifying the slight movements of their armatures through the medium of local magnets and an electric motor, the latter finally performs the mechanical labor of cutting cells in and out of the circuit as the potential varies.

Referring to the accompanying diagram, L, L, is the working circuit containing the lamps, and D the dynamo which may be connected directly to the lamp circuit by closing switch S on its upper contact. B is the battery of accumulators and at E are several counter-electromotive force cells connected in series with the battery, but with opposing poles. The lower contact of switch S is connected, as shown, to the junction of the battery and counter-electromotive cells, and to a non-break cell-regulating switch K, to which the negative terminals of the counter-electromotive force cells are brought.

The arrangement so far described is the ordinary method of installing accumulators for hand regulation in connection with a simple multiple arc plant, and it is operated as follows: Supposing the dynamo to be running, the switch S is on its upper contact, and the lever of switch K turned to the left so as to break contact; then the current from



Prescott's Method of Regulating Storage Batteries.

the dynamo flows directly into the lamp circuit while the battery circuit is open at K. If the switch K is now closed, the battery will be joined in parallel with the dynamo and will add its current to the lamp circuit. A galvanometer placed in the wire leading from K to S would show the amount of current flowing out of the battery and this could be increased, or diminished, by turning the switch K to the left, or right, respectively, and thus removing from, or placing in, the battery circuit more or less of the counter-electromotive force cells.

Assuming now that the lamp load is diminished and that the dynamo can generate sufficient current to charge the batteries as well as supply the number of lamps required, the switch S is quickly moved to its lower contact. The positive current from the dynamo passing through S has now two paths when it reaches the junction between the battery and counter-electromotive force cells, one through the battery, which thus receives a charge, and back to the

other pole of the dynamo; and the other through such of the counter-electromotive force cells as may be in circuit, depending upon the position of switch K, then on through the lamps and back to the negative pole of the dynamo. The potential of the dynamo must now be increased in order to force current through the battery, while the switch K is simultaneously moved to the right, thus opposing additional counter-electromotive cells to that part of the dynamo current going to lamps, until the pressure at the terminals of the working circuit is normally restored.

It is of course to be understood that the attendant who moves the switches is governed by a pressure indicator located in the dynamo room and connected with the lamp terminals. When the battery is sufficiently charged the operation described is merely reversed.

While not an essential part of this method of regulation, although a valuable adjunct, it is pertinent to mention that there are several forms of these switches which are entirely automatic in their action, cutting the battery in or out of circuit when the dynamo starts or stops, or when the potential of the battery varies to require it. One of the earliest and most practical forms of such an instrument was also devised by Mr. Prescott several years ago.

In the light of what has preceded, it will readily be seen that the switch K may be operated by a motor automatically controlled through the medium of local magnets, by a delicate potential indicator connected to the lamp terminals.

In this system the potential instrument consists of two ordinary, but very sensitive, high resistance telegraph relays. These are shown in the figure at m, m_1, the coils of the two relays being joined in series and connected to the lamp mains, at a point of average pressure.

Again referring to the diagram, it will be seen that the local armature circuits of the two relays are each in the circuit of one of the magnets of the local instrument P, the local battery b being common to both. The device P is an electro-magnetic pole changer, consisting of two pairs of electro-magnets standing vertically side by side, between which is a pillar carrying a centrally pivoted armature A, normally occupying a horizontal position. This armature is tilted to the right or left, respectively, as the circuit of the right or left magnet is closed. Mounted co-axially on this armature, but insulated from it, are two horizontal copper rods W, their ends bent down so that when in the normal horizontal position they just clear the mercury cups C C_1. These two copper rods and the four mercury cups constitute an ordinary reversing switch. The mercury cups are connected through the local battery e, with the field of the motor M; the armature of the motor being in turn connected with the rods W.

The operation of the regulator is as follows: Assuming the dynamo to be running and the pressure on the lamp circuit to be normal, the retractile springs of the relays are so adjusted that the armature of m is barely attracted, and the armature of m_1 is barely released, so that the local circuits of both magnets of the pole changer are open. When a delicate adjustment has been made, a slight increase of the pressure on the lamp circuit will cause the armature of magnet m to be more strongly attracted, still keeping its local circuit open. The armature of magnet m_1 will also be attracted, but will move and close the circuit of the battery b through the right hand magnet of P, causing the armature A to be tilted to the right and to plunge the ends of the wires W into the mercury cups C. This closes the circuit of the battery e through the motor, and causes it to revolve the switch k in such a direction that counter-electromotive force cells are inserted in the lamp circuit, thus reducing the pressure. When the pressure again becomes normal the armature of m_1 is pulled back by its retractile spring, breaking the local circuit and allowing the armature A to resume its normal position and stop the motor.

When the potential becomes reduced from any cause, both relay armatures are pulled back by the springs, that of m_1 still retaining its position on back contact and leaving the local circuit open; while that of m moves against its back contact and closes the local battery b through the left hand magnet of P. This causes the armature A to tilt to the left and plunge the opposite ends of the wires W into the mercury cups C. As previously, the circuit of the local batery e is closed through the motor, but this time the current is reversed through the armature of the motor and causes it to revolve the other way. This moves the switch K in a direction opposite to that in which it turned before and cuts out counter-electromotive force cells until the normal potential is again restored; and so on, whenever the pressure changes, whether from variation in the potential of the battery, alteration in the speed of the dynamo or change in the lamp load. It is hardly necessary to state that the counter-electromotive force cells serve as the local batteries b and e, these having been shown as they are in the diagram for the sake of clearness.

The apparatus described has been made by The Accumulator Co., of this city, and the method found to give very satisfactory results.

TELEPHONIC SPECIFIC INDUCTIVE CAPACITY.

BY WILLIAM W. JACQUES.

Electrician of the American Bell Telephone Co.

In a paper on "The Construction of Telephone Circuits," read before the American Academy of Arts and Sciences on the 15th of June, 1887, the writer of the present article pointed out, "that the readiness with which telephonic conversation may be carried on over any circuit, whether made up of cables or pole lines, or both, depends,—

"1. On the total electrical resistance of the circuit joining together the two stations.

"2. On the total electrostatic capacity of this circuit."

And the general rule was laid down:—"No matter what may be the distance between two points, good business conversation may be carried on between them, provided they be connected by a pole line or cable, or both, the product of whose total resistance by its total capacity is less than 2,000, if transmitters of the Blake type be used, and less than 4,500 if transmitters of the Hunnings type be used."

This rule was enunciated as the result of an extended series of experiments carried out in England, France, Germany, and the United States on pole lines, cables, and mixed pole and cable lines, varying widely in mechanical and electrical dimensions.

The same law, only applied to the transmission of signals through submarine cables, had been previously worked out mathematically by Sir William Thomson, and amply confirmed by experience, so that to-day there can be no doubt of its truthfulness. It is evident, therefore, that in the construction of a telephone line, it is desirable to reduce both the *resistance* and the *capacity* to a minimum.

In a pole line, since the wire is suspended high above the earth, the capacity is always small, and the resistance is the factor that we must try to keep down. In cable lines, however, where the conductor is necessarily brought near to other conductors, or a metal shield, or the earth, the capacity becomes quite an important factor to be respected. In lines made up, as is most generally the case, of a comparatively short section of cable and a larger section of iron pole wire, the capacity of the cable becomes pre-eminently the factor to be respected; for, since the limit of conversation is here determined by the product of the capacity of the cable and the resistance of the whole line, a small percentage of saving in the capacity of the cable gives an enormous gain in the readiness with which conversation may be carried on over the line.

It becomes of vital importance, therefore, to choose an insulating material for telephone cables of low specific

inductive capacity. Further than this, since it is well known (Gordon's "Electricity and Magnetism," Chap. XI) that the specific inductive capacity of any insulating material, and consequently the capacity of any cable insulated with it, is very different for telephone currents from what it is for telegraph currents, because the charge and discharge take place so much more frequently, we may say that it is of vital importance to choose an insulating material of low "telephonic specific inductive capacity," using this expression in contradistinction to "telegraphic specific inductive capacity," by which we mean the values measured in the old-fashioned way.

In the *Proceedings* of the American Academy for Dec. 11, 1889, Messrs. Safford and Holman, two graduates of the Massachusetts Institute of Technology, in the Department of Electrical Engineering, have published the following table of telephonic specific inductive capacity of various insulators used in cable construction. This table is a result of an elaborate and careful research undertaken by them.

TABLE OF SPECIFIC INDUCTIVE CAPACITIES, MEASURED BY TELEPHONE CURRENTS.

1. Petroleum	1.6
2. Solid paraffine	2.0
3. Cotton saturated with paraffine in vacuum	2.0
4. Cotton boiled in paraffine	2.6
5. India-rubber	3.7
6. Artificial gutta-percha	3.9
7. Gutta-percha	4.2
8. Glass	4.6
9. Water	6.3

Realizing that these results were of great practical importance in the construction of telephone cables, the writer has repeated the experiments of Messrs. Safford and Holman with entirely concordant results.

Let us see some of the conclusions we are obliged to draw from the data thus furnished, and then, in order to confirm these conclusions, we will describe some further experiments in this line.

I. The specific inductive capacity of any insulator used in the construction of telephone cables, and, consequently, the actual electrostatic capacity of any given telephone cable, ought to be measured with charges and discharges of telephonic frequency, and not by the old-fashioned method of measuring capacities by slow charge and discharge. This last is of no value, while the telephonic capacity is of vital importance.

II. The presence of water in an insulating material greatly increases its telephonic specific inductive capacity. An inspection of this table shows that, so far as capacity is concerned, petroleum is the best substance to be used, and doubtless this would be the case were it possible to keep it free from water, but water, we see from the table, has a specific inductive capacity of 6.3, so that its presence in the petroleum raises the capacity from the lowest to the highest in the list.

This observation is borne out by actual experience with cable No. 1 in telephony. When new, and the petroleum dry, it works excellently; but as water finds its way in, the cable rapidly loses its efficiency for telephonic work.

This action of the water is quite different from its action as a *conductor* to produce leakage, for the loss of electricity due to leakage in such a cable that has lost its efficiency from the presence of moisture, is entirely insufficient to account for the deterioration.

So, too, in the cable, No. 4, the presence of moisture exercises a detrimental effect on the power of the cable to transmit telephonic currents, and increases the inductive cross-talk to a degree that cannot be accounted for by the diminished insulation resistance.

It is proposed to show later that the presence of moisture in a lead covered cable, does actually increase very greatly its telephonic capacity, and, consequently, both the retardation and cross-talk.

III. Next to petroleum, solid paraffine is seen to be the best substance to use; but on account of mechanical difficulties it has never been found practicable to coat wires directly with solid paraffine.

If the wires are wound with cotton and then boiled in paraffine, as they are in making cable No. 4, the specific inductive capacity is raised to 2.6, an increase of 30 per cent., which, we have seen, is a very great detriment.

If, however, the wires are wound with cotton, and the air and moisture removed by the aid of heat and a vacuum, and they are then boiled in paraffine, from which the air and moisture have also been removed by heat and vacuum, the specific inductive capacity again falls to 2.0, which is the same as that of solid paraffine. This is the process used in preparing the cable No. 3.

It is probable that the inferiority of cable No. 4, as compared with No. 3, is due largely to the moisture retained in the cotton, which we have seen has a capacity of 6.3.

Leaving the paraffine cables, rubber is the next best, then gutta-percha, and poorest of all is glass; but all of these latter substances have so high a specific inductive capacity as to entirely unfit them for telephonic work.

It now becomes desirable to put this information in more available form, for the use of those upon whom the selection of the best cables for use in telephone construction devolves.

Accordingly, I have given in the following table, first, the telegraphic capacity; second, the calculated telephonic capacity; and third, the measured telephonic capacity of one mile each of cables Nos. 3, 4, 5 and 7, all constructed on the dimensions of the "conference standard."

The measurements of the cables Nos. 3 and 4, were made on cables actually constructed in accordance with the requirements of the conference standard. Those of the rubber and gutta-percha cables were made on cables of a different specification, but reduced to the conference standard by well known and accurate methods of calculation.

Capacity of One Mile of Conference Standard Cable, in Microfarads.

	Measured telegraphic capacity.	Calculated telephonic capacity.	Measured telephonic capacity.
Cable No. 3	.18	.18	.18
" " 4	.19	.24	.26
" " 5	.27	.30	.30
" " 7	.40	.46	.40

In order to show how great a difference in the practical working of a line this difference in telephonic capacity makes, let us assume a conversation to be carried on between two subscribers, connected by five miles of conference cable, and 40 miles of No. 12 iron pole wire.

Let us first suppose cable No. 3 of the conference specification be used.

Resistance 40 miles No. 12 iron wire	=	1,184 ohms.
" 5 " cable,	=	175 "
Total line resistance,	=	1,359 "
Capacity 40 miles No. 12 iron wire (30-foot poles),	=	.48 micro-farad.
Capacity 5 miles No. 3 cable,	=	.90 "
Total line capacity,	=	1.38 "

Product of total resistance and total capacity (1,359 × 1.38) = 1,875, which product, being considerably less than 2,000, shows us that conversation could easily be carried on over such a line with Blake transmitters.

Let us next suppose cable No. 4 of the conference specification to be used.

Resistance 40 miles No. 12 iron wire = 1,184 ohms.

" 5 " cable,	=	175 "
Total line resistance,		1,359 "
Capacity 40 miles No. 12 iron wire (30-foot poles),	=	.48 micro-farad.
Capacity 5 miles cable No. 4	=	1.30 "
Total line capacity,		1.78 "

Product of total resistance and total capacity (1,359 × 1.78) = 2,419, which product is considerably above 2,000, and good commercial conversation could not be carried on with Blake transmitters.

NEW THOMSON-HOUSTON ELECTRIC SNOW-PLOW AND SNOW-SWEEPER.

Past experience in operating electric railways in winter has demonstrated the fact that some appliance is needed for keeping the tracks as free from snow as possible. That the Thomson-Houston Electric Company fully realized this is shown by the forethought manifested in preparing the snow-plow, Fig. 1, and snow-sweeper, Fig. 2, shown in the accompanying illustrations. Last winter's experience with snow showed just what was needed in this direction, and in the new appliances will be found many improvements over the old types. The details of the snow-plow are as follows: Length over all, 20 feet; width, 7 feet; height from rail to floor of car, 3 feet, 6 inches. The truck has four 36 inch wheels, in front of which is placed a digger which scrapes the snow from the track, thereby securing a good contact for the wheels. These diggers, or scrapers, are controlled by levers placed at each end of the car, and may be raised and lowered at will. One of the main plows is placed diagonally across the car, one end being in front of the forward wheel on one side, the other end coming out between the front and rear wheels on the opposite side, at an angle of about 60 degrees. By placing the plow in this manner a position is secured where the least oscillation occurs. Although the plows extend 2 feet beyond the wheels, each is provided with an extension, by means of which a path of any desired width, depending upon local conditions, can be plowed out. The second main plow is hung parallel to, and in the same manner as, the first, each, however, being independent, and controlled by levers placed upon the car platform. One or both can be used as the circumstances require. The plows are kept at a proper angle by means of chains and iron rods, so arranged as to permit great freedom of movement in a vertical direction.

The car is propelled by two 20 h. p. motors, of the consequent pole type, one being geared to each axle by means of sprocket chains and chain gear wheels. They are capable of propelling the car at a speed of 10 miles an hour. The sprocket chains run as slowly as possible, since the total reduction in speed is made by gears on the motor frames. They are enclosed in closed iron boxes. In circuit with the motors is placed a reversing switch and rheostat, also placed in a closed iron box. The trolley arm is supported by a post placed in the centre of the car platform, and which is also used as a support for a number of incandescent lamps. The car can be operated in either direction.

Fig. 1.—New Thomson-Houston Electric Snow-Plow.

The car for the snow-sweeper is of the same dimensions as that used for the plow, the wheels being 36 inches in diameter, and mounted on a $3\frac{1}{2}$ inch axle. The motors for driving the car are of 15 h. p. each, and are entirely independent of the motors used for driving the brushes, being provided with separate reversing switch and rheostat, enclosed in an iron box, and placed on the platform in easy reach of the operator. The motors for operating the brushes are placed on the car platform, with a shaft parallel to that of the broom, and connected to it by means of sprocket chains, so as to run at a speed of 200 revolutions per minute. The brushes, which are placed in advance of the truck, are two in number, and are made in sections to facilitate taking apart and placing upon the drum to which

they are fastened. On the platform of the car on both sides are handles operating clutches by means of which the brooms can be thrown in or out of operation. Levers are also provided for raising and lowering the broom, thereby rendering it possible to operate them at any desired height. To insure the snow being thrown off the track, the brooms are set at an angle of 60 degrees to the rail. The electrical connections are the same as found on the passenger cars, the motors for propulsion being connected in multiple, but independently of the motors used for driving the brushes. The current is taken from the overhead conductor by means of a trolley, supported on a post eight feet high placed in the centre of the car. Around this post are grouped incandescent lamps which are employed when the car is required for night service. Both the snow-plow and sweeper are made for severe work, and have proved in previous tests to be fully capable of responding to every demand made upon them.

FIG. 2.—NEW THOMSON-HOUSTON SNOW-SWEEPER.

TALK OF A NEW TELEGRAPH COMPANY.

It has been whispered on the stock exchange, and the rumor has gained general circulation among down town business men, that three or four New Yorkers had started out to form a new telegraph company. If the story is to be believed, the intention of the enterprising New York men is to enlist English and French capitalists in the scheme. The Western Union people have received no definite information in the matter and are inclined to discredit the rumor. A member of the governing committee of the stock exchange said: "I have my suspicions that somebody has been inventing a yarn for the purpose of depressing the prices of the stocks in the existing companies. My opinion is that neither the Western Union nor the Postal people have any good reason to fear that there will be a new rival in the field."

OTTAWA, CAN.—The Chaudiere Electric Light and Power Co. has increased its capital stock to $500,000.

When all the cars are run by electricity, the term "lightning express" will be no misnomer.—*Boston Gazette.*

WENSTROM ELECTRIC MINING PLANT AT CLEARFIELD, PA.

The Clearfield Bituminous Coal Corporation have just completed an electric pumping plant at their "Grass Flat" mine at Peale, Clearfield County, Pa. This mine is opened by three drifts, Nos. 9, 10 and 11; the headings of Nos. 9 and 10 are parallel, but distant from each other about 1,200 feet.

On the surface a stream runs between these two headings and affords no cover for their connection and without offering the necessary level for a water drift. Three thousand feet from the drift mouth heavy dips in both drifts were met, producing large quantities of water.

To meet the difficulty by steam power would have necessitated two shafts, approximately 100 feet deep, to be sunk, and two pumps and boilers to be located inside of the mine. To obviate this, expedite the work and to avoid large first cost, the electric plant was put in with marked success. The apparatus consists of an eight h. p. Wenstrom compound dynamo, a five h. p. Wenstrom motor for the pump in No. 9, and the same make of motor of one and one-half h. p. for the pump in No. 10.

The dynamo, with Lidgerwood engine and boiler, is located at the mouth of the drifts and furnishes power to both pumps. The five h. p. motor located 3,000 feet from the dynamo is running a Gould rotary bronze pump with capacity of 15,000 gallons per hour, elevating the water 22 feet for a distance of 520 feet, whence it flows off by natural drainage. The smaller motor in No. 10 will control a centrifugal pump with a capacity of 2,400 gallons per hour, elevating 15 feet for a distance of 400 feet. The larger pump is in daily operation, running, when needed, to its full capacity and giving complete satisfaction. The small pump will be put in on completion of some connections in the mine.

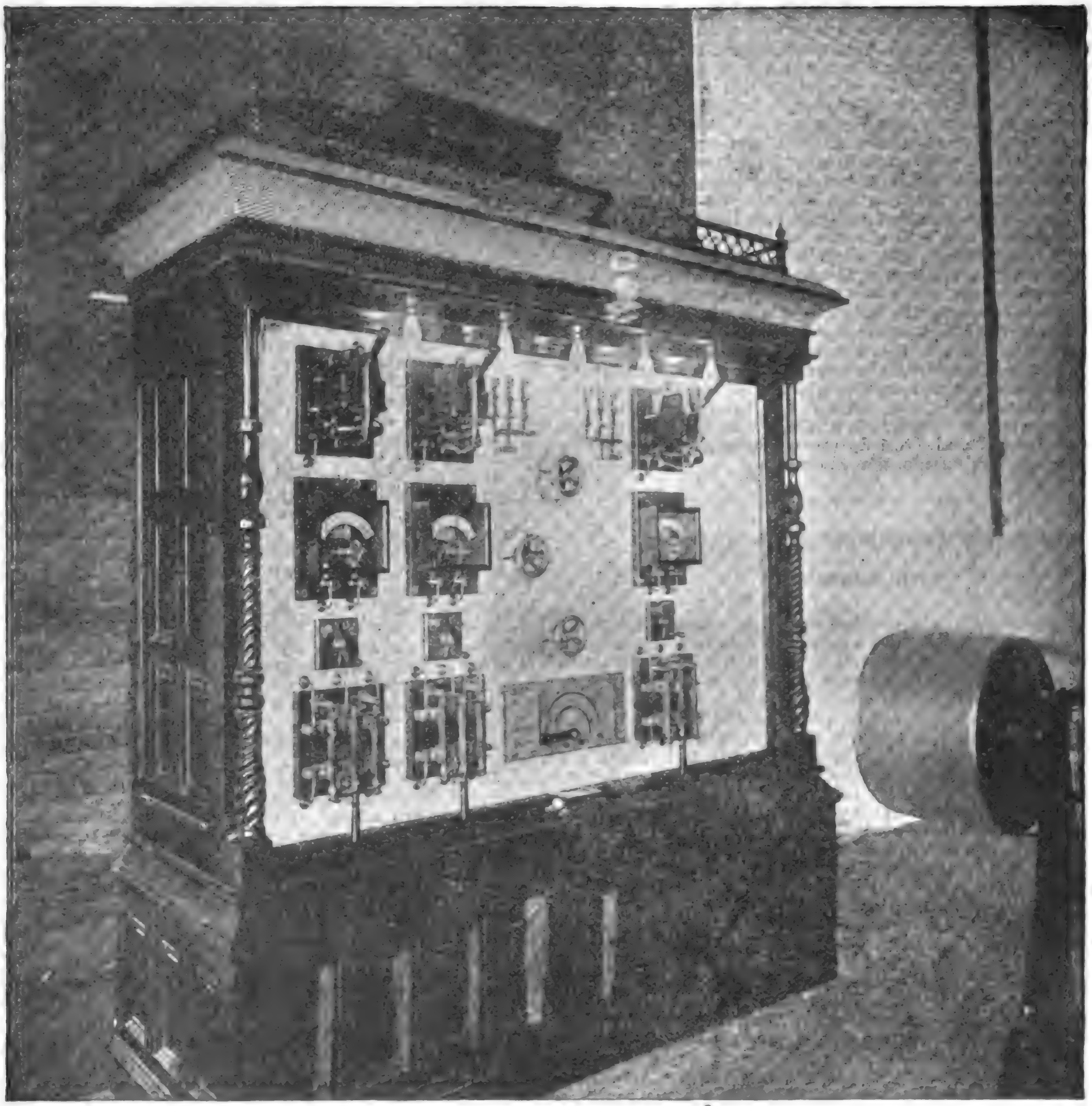
Two men operate this plant; one as engineer attending engine-boiler and dynamo, and one looking after both pumps, as the only attention needed is the oiling. Mine owners will be interested in this system of pumping which is somewhat of an innovation in the region, and which Superintendent Shillingford has demonstrated to be a great success.

WESTERN UNION IN LONDON.—News comes from London of a revival of the scheme to list Western Union stock upon the London Exchange. It is said that John Mackay's influential friends there will not oppose the plan this time.

MR. PAUL T. BRADY, of Cooperstown, N. Y., is to have charge of Thomson-Houston interests in this State outside of New York city, with headquarters at Syracuse.

THE MARBLE SWITCHBOARD OF THE CITIZENS' STREET RAILWAY, INDIANAPOLIS, IND.

The Citizens' Street Railway, Indianapolis, Ind., has been in operation since June 8th, 1890, and is asserted to be the best constructed electric railway in the country. The central pole double bracket construction has been used throughout, the poles being of heavy iron pipe with fancy bracket and arm attached to each side of the pole, extending over the centre of each track, supporting the trolley wire. This construction runs through the business portion of the city. On this line are a number of difficult curves, which required considerable engineering skill to conform the overhead wire to the line of track. They are at present operating 10 motor cars, equipped with two 15 h. p. motors, and each motor car at all times hauling a trail car. The traffic on this road since starting has been larger than the most sanguine had anticipated, and has been in operation without the slightest delay or trouble. The cars were manufactured by the St. Louis Car Co., of St. Louis, Mo. The power station is equipped with one 250 h. p. Wheelock engine, Corliss type, and one 500 h. p. Hazelton boiler, and natural gas is used instead of coal. Two 30 h. p. Thomson-Houston generators are installed in this station, together with an elegant marble switchboard, here shown, which has upon it circuit breakers, amperemeters, voltmeters, switches, rheostats and potential boards, and taken altogether it is one of the finest stations which has been equipped in this country. The Thomson-Houston Electric Co. is at present building one large electric snow-sweeper for this railway, which will be used to remove the snow from their tracks during the winter months.



Marble Switchboard, Citizens' Street Railway, Indianapolis, Ind.

VISIT OF ENGLISH ENGINEERS TO AMERICA.

The present week sees gathered in this city about 150 to 200 English engineers and capitalists interested in metal working. The visitors include Mr. F. W. Siemens, Mr. James Dredge, Prof. Kennedy and others known in the electrical field. Monday and Tuesday will be devoted to the sessions at Chickering Hall of the American Institute of Mining Engineers. On Wednesday and Thursday will follow the session of the International Iron & Steel Institute, at which Prof. Elihu Thomson will read a paper on electric welding. On Friday, a party will visit the Edison Laboratory. After this week the visitors scatter, to gather here again in November for the homeward voyage to England.

AN EASY MODE OF PRODUCING THE ACTIVE SPARK IN HERTZ'S EXPERIMENTS.[1]

BY H. CLASSEN.

In repeating Hertz's experiments in the State Physical Laboratory at Hamburg, an observation was made which shows how in a simple manner we can overcome the difficulty experienced by many observers of keeping the primary spark effective for a long time together. In the same manner in which Rijke used the action of a current of air on the make-and-break spark of an induction-coil in order to produce a stronger action in the secondary coil, so may the spark of the coil itself, and therefore also its inductive action on any other conductor, be similarly influenced.

In the experiments a large Ruhmkorff's coil was used which had a very rapid contact-maker, and which gave sparks up to 14 centimetres. If the ends of the secondary coil are loaded with conductors, and the discharging knobs are brought within a distance of a few centimetres, the discharge takes place mostly in the form of a continuous rose-colored strip of light, and is useless for Hertz's experiments. But when this band is blown away so that flames a centimetre in length project on the side, sharp, brightly luminous sparks occur between the knobs. The current of air produced by a Münke's water-pump was now blown continuously between the knobs, and thus a series of sharp cracking sparks passed quite continuously, and could without difficulty be continuously maintained for hours. A series of Hertz's experiments could now be repeated, and even when the current of air was replaced by one of steam the action was the same. The whole process suggests the idea that, in the ordinary discharge with a luminous band of light, detached metallic particles effect a permanent conduction, and that the essential discharge-spark is only produced as these particles are blown away. The influence of the ultra-violet illumination, too, which has been designated by various observers as highly disturbing, would, after the researches of Lenard and Wolf on the pulverization of bodies by illumination, find an explanation in this.

ON THE EXPERIMENTS OF HERTZ.[2]

BY L. BOLTZMANN.

I have successfully demonstrated to a large audience the sparks which pass between a knob and a point in Hertz's experiments on rays of electrical force, by connecting the knob with a very sensitive electroscope, and the point with the pole of a suitable galvanic battery the other pole of which was put to earth. As long as there were no minute sparks or *scintillæ* the electroscope remained uncharged; but when these were formed they established a connection between the knob and the point and caused the leaves to diverge. In this manner I was able to show with certainty the scintilla produced by a single primary spark when the primary and secondary inductors were at a distance of 36.8 metres apart, the greatest distance available.

At a distance of 8.7 metres all the Hertz experiments could be most conveniently demonstrated before an audience of about 200, so as to be visible to every one; only three or four primary sparks were required for each experiment, by which the electrodes could be kept brightly polished. Dust, cracks in the metal, or an impure greasy condition of the surface, appeared more injurious than the layer of oxide; cleaning with dilute sulphuric acid, distilled water, and then dry rubbing was found to be the best; a thicker layer of oxide is removed by polishing with French chalk (moisttened with spirit), in which case dry rubbing is sufficient. I was not able to see any advantage in a current of air as recommended by Dr. Classen.

The length of the secondary spark produced at the great distance of 36.8 metres I estimated at $\frac{1}{5000}$ millimetre as the maximum. As the dry pile which served to charge the electroscope had a potential of 200 volts, the knob and the point were adjusted at a distance which exceeded by about $\frac{1}{5000}$ the striking distance of the dry pile, the discharge of which was then set up by the addition of Hertz's waves to the tension of the dry pile. By using a much more feebly charged battery instead of the dry pile, and a much more delicate galvanoscope, Hankel's for example, the rays might be perceived at still greater distances. In the latter case it might not be impossible to measure the deflection with a view to quantitative determinations. The regulation of the distance between the knob and the point must then be made so much the finer.

I also made experiments on interference by reflecting the waves from the primary parabolic mirror through two plane mirrors, which, like those of Fresnel, formed an obtuse angle, and whose planes were at a distance of fourfold a half wave-length. This method seems well suited for accurate measurements of the wave-length and of the decrement of the vibration.

1. Abstract from the *Phil. Mag.* 2. Abstract from *Phil. Mag.*

HOW TELEGRAMS ARE SENT IN LONDON.[1]

Suppose you want to send a telegram from the City to Charing Cross. You go to an office—say that in Threadneedle street—write your telegram, put the stamp on it, and hand it over to the clerk, satisfied that it will go. It does go, and in the following manner: The clerk numbers it (for every message sent is numbered), obliterates the postage-stamp in the usual way, and hands it over to a boy. The latter folds it up lengthwise and places it in a "carrier," which is a tube about eight inches in length and two inches in diameter, made of India-rubber covered with felt. Of course one carrier will hold several messages; it is closed at one end, open at the other, but provided at the open end with an elastic band which keeps the messages securely inside. The carrier is then put into the pneumatic "shoot," which is a metal tube or pipe laid under ground and leading into the Central Telegraph Office at St. Martin's-le-Grand. The felt-covered carrier exactly fits the interior of the pipe and is drawn along by suction. In the course of a minute or so it arrives at the central hall on the ground floor in the Telegraph Department of the General Post-office. Here its approach is signalled by an automatic indicator, and presently a click announces its arrival. It is at once withdrawn from the shoot by a boy, who takes out the messages contained and hands them over to a sorter. The sorters sit, some six or eight in a row, at a long table opposite the row of pneumatic tubes, each of which is connected with a City or West-Central office, and rapidly sort the continually arriving messages as they are handed to them by the boys who attend the tubes. The messages are sorted according as they are metropolitan, provincial, foreign, or for central London, and placed in corresponding pigeonholes; from which they are immediately removed by more boys. Our Charing Cross message is for central London; so it is carried, of course with many others, to the other side of the same hall, where the corresponding departure tubes are situated, handed again to a sorter, sorted, pigeonholed, and again removed, to be despatched by the Charing Cross tube. Arrived there it is copied out and sent to its destination by the hands of the familiar telegraph boy.

In all this, it will be seen, there is no telegraphing. The messages are despatched bodily from a branch office to a central and again sent out bodily to the office of destination. This, however, only applies to the city offices, those of Fleet Street and the Strand, and the W. C. office in Holborn. All these are provided with tubes in connection with St. Martin's-le-Grand, as are also some of the foreign cable offices. Some offices have two—one "up" and one "down"; but most are served both ways by the same tube. There are in all forty-two of them—exclusive of thirty-one working locally within the building—and they are worked by four large steam-engines on the premises; "up" messages going by suction, "down" by pressure. The longest is an extension of the Charing Cross tube to the reporters' lobby in the House of Commons, and is two and a half miles long. Messages take from five to seven minutes on the journey. So much for central London telegrams.

If now we want to send one from the city to Hampstead, its course is the same as that already described as far as the sorters' table, in the tube-room of the central office. There it will be put among metropolitan messages and despatched by another tube to the "Metropolitan" Gallery, on the fourth floor of the same building. Once more it is collected and passed through the sorters' hands, and then taken to the Hampstead table, where a telegraphist despatches it by wire to the office of destination. A return telegram from Hampstead to the city traverses precisely the reverse route. It is received by wire at the Hampstead table, collected, sorted, sent by tube to the ground floor, sorted again, and despatched by tube to the city office. A London telegram to the provinces, or one from a town in the south to a town in the north, goes similarily through the central office. On arriving there (either by tube or wire) it passes through the sorters' hands, is despatched to the "Provincial" Gallery, sorted again, and then sent off by wire.

The Central Telegraph Office is the very heart of the machine, through which every drop of blood passes, to be transmitted in one direction or another. The activity of that vast industrial hive is prodigious. It has been often described; but some of the facts will bear repetition. The staff of telegraphists numbers 1,845 males and 807 females, and there are in addition 627 messengers. Something like 100,000 telegrams are dealt with every day, the half of which are really double, having to be both received and forwarded. On busy Parliamentary nights the number of words despatched is not infrequently over half a million, and the total has exceeded a million. Perhaps the most remarkable room in the building is the "Provincial" Gallery. The telegraphists sit at tables bearing the names of the towns with which their wires are connected, and work the various instruments, while the destributors bring and take away the messages. There are 421 instruments in this room, of no fewer than ten different kinds. Some idea of the work done may be gathered from the fact that the Liverpool wires alone are served by forty telegraphists; and how it is done on the whole the public knows very well in spite of occasional grumbling.

1. *St. James Gazette.*

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.
Anonymous communications cannot be noticed.
The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.
In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.
Sketches and drawings for illustrations should be on separate pieces of paper.
All communications should be addressed EDITOR OF THE ELECTRICAL ENGINEER, *150 Broadway, New York city.*

THE "HEDGEHOG" TRANSFORMER DISCUSSION.

[140.]—I was much interested in Mr. Nikola Tesla's arraignment of Mr. Swinburne's "hedgehog transformer," which appeared in your last issue (Sept. 24, p. 332), and especially so for the reason that I have for some time favored the open circuit transformer as superior to the closed circuit in point of efficiency, and I was anxious to hear the arguments on the other side. Mr. Tesla's article was rather disappointing, however, as I was unable to see the force of most of his arguments.

Mr. Tesla says, for example: "In order that the loss in the iron should be reduced to one-tenth, it is necessary to reduce the weight of the iron to one-tenth, and subject every unit length of the same to the same magneto-motive force." The laws of hysteresis, as given by Ewing and Hopkinson, state that hysteresis loss varies directly as the weight of iron, and as some function of the density of magnetization, or number of lines per square centimetre. The hysteresis loss can, therefore, be lessened by increasing the cross section of the core, as well as by decreasing the weight, and Mr. Swinburne states that the cross section in his transformer is increased.

A little further on Mr. Tesla remarks that the loss in the iron is proportional to the square of the M. M. F. per unit length of core. If I have not misunderstood this, Mr. Tesla must have discovered some law of hysteresis which has not yet been published, for I can find no statement in Ewing's or Hopkinson's paper that M. M. F. affects hysteresis in any way.

Some other statements of Mr. Tesla are rather hard to reconcile; as, for instance, he says: "In this case * * an advantage will be gained, as the total magnetic resistance will be diminished. The four transformers will now demand less excitation, and since * * * the gain depends on the square of the exciting current, it is by no means insignificant." And in the next paragraph: "Mr. Swinburne is in error as to the motive which caused the tendency to shorten the magnetic circuit in closed circuit transformers; it was * * * not to reduce the magnetic resistance, which has little to do with efficiency." These two statements do not seem to agree remarkably well, and a little further explanation would be of advantage.

Further on Mr. Tesla says that if the wires are "wound side by side" (a rather obscure expression) a shorter magnetic circuit will give a better result. He does not mention in what regard the result would be better, and it would be interesting to know. I presume, that he does not mean that the result would be better efficiency, for he has said that efficiency does not depend on length of magnetic circuit.

Finally, Mr. Tesla says: "Mr. Swinburne states that in his transformer the loss in iron is under 1 per cent. of the full load; all the balance of the loss must, therefore, be in copper. But since, according to him, the wires are of larger section, his transformer can hardly be an improvement in that direction." It appears to me that any increase in the cross-section of the wires will decrease their resistance, and thus decrease their C^2R loss. The change in the angle of lag, if it be appreciable, would be in the direction of less loss.

The objection to the gun metal casting appears to be well taken; but as this applies merely to Mr. Swinburne's transformer and not to open circuit transformers in general, in which I am especially interested, I will leave Mr. Swinburne to defend that for himself.

In conclusion, the fact that the open circuit transformer that Mr. Tesla designed required a larger number of alternations than are commonly used, does not prove that an open circuit transformer may not be designed to use the ordinary rate of alternation. I hope Mr. Tesla will clear up these matters, since his article is, to say the least, a little obscure. THORBURN REID.

NEWARK, N. J., September 26, 1890.

AN ELECTRICAL CONUNDRUM.

[141.] The following passages occur in a set of specifications for an electric light plant for a Philadelphia concern, and the writer was applied to by one of the bidders to explain the meaning of the two restrictions. It is rather an electrical conundrum and I should like to have some of your readers furnish the answer if possible. PUZZLED.

"The loss of electromotive force will not exceed five (5) volts from the terminals of either dynamo—when run at 110 volts between said terminals—and any lamp when the full complement of lamps are burning at their standard c. p. This result will be strictly adhered to."

"The lamps will be 110 volts, 16 c. p. and average not more than 6-10 of an ampere per lamp."

EUROPEAN CORRESPONDENCE.

LONDON.

The British Association.—The Value of the Ohm.—Lighting of English Towns.—Electric Traction.—Electric Lighting of London.—Lighting of Newspaper Offices.—Train Lighting.—Berlin Post Office.

THE meeting recently concluded at Leeds did not collect so large a number of persons as is usually to be found at such gatherings. A good many electrical papers were presented, and in one or two cases excited considerable discussion. By far the most interesting was the report of the Committee on Electrical Standards, many leading scientists taking part in the discussion. Mr. Glazebrook on behalf of the committee said the conclusion arrived at was that the time was ripe for taking into account an alteration of the ohm. Sir William Thomson, Lord Rayleigh, and Mr. Preece entered into the discussion, and the views expressed by the speakers were entirely in accord with the recommendation of the committee. Prof. Rowland gave a short account of the experiments that had been made in America. Prof. Barker following, said they would be fully prepared in America to adopt as the length of a column of mercury of one square millimetre section 106.3 laid down by the committee. He asked Englishmen to assist them in return to get in the name of Franklin somewhere as the name of a unit.

In virtue of this action of the British Association, it will probably not be long before something definite is done.

Sir Wm. Thomson's paper on anti-effective copper proved one of the best practical papers presented during the meeting. As you will see by the paper, though the resistance of a conductor may be reduced as its cross section is increased, a thickness is soon reached at which an addition of copper causes an increase in the heat generated by the alternating current. When one is therefore limited to a given weight of copper to produce the most economical results, it is evident that the metals should be of the highest purity, and I imagine that there is a great field in this direction for the electrically deposited copper wire manufactured by the Elmore Company.

The figures given in Mr. Preece's paper "On the Character of Steel used for Permanent Magnets," show that the French specimens of magnet steel are much superior to the English. Prof. John Perry said that the fact gave rise to the question whether they had not some secret method of tempering not possessed by them in England.

Among the grants made for scientific purposes, there was one for £100 granted to the Committee on Electrical Standards. Next year the meetings will take place at Cardiff under the presidency of Dr. Huggins, the astronomer.

There is considerable activity shown at this period in the lighting by electricity of English towns. A notable example is Bristol, at which place the Town Council have taken the lighting into their own hands. It is proposed to erect about one-hundred lamps of 1000 c. p. each in the streets. The work will be begun shortly. We may expect in the next two or three months considerable development in this direction in Huddersfield, Derby, Dundee and several other large places. In connection with municipal lighting, I may mention that the town authorities appear very anxious to keep the lighting in their own hands, and thus prevent what is by them termed a hurtful monopoly. They ever keep in their minds the gas interests, which are widely different from anything that could arise under the Electric Lighting Acts. If they do the lighting well, it may certainly be good for the consumers, though many authorities here declare it cannot be done so well as by private companies.

Seven electric omnibuses will be placed on the road between Kings Cross and Victoria (3¼ miles) in a few days by Ward & Co. They will run at the same fare as the horse cars now on the road. Each bus will carry 26 passengers, 12 inside and 14 outside, attended by the usual driver and conductor. The vehicles are worked by 60 19-plate E. P. S. accumulators fixed in the bottom. They work about three hours a day and are then recharged. For the past few months one or two cars have made experimental journeys through the most crowded streets of London.

It is said that the City & South London Railway, running from London to Stockwell, which will be entirely worked by electricity, is to be opened in one or two months, although up to the present time no information of a technical nature has been given to the electrical press. The engineers are evidently anxious to keep out criticism on the incomplete work. One or two schemes, I may say, are waiting the trial of this one before proceeding any further with their work.

The Corporations of Leeds and Edinburgh are considering the question of electric traction, and according to the latest accounts it is probable that the former place will make the experiment of running electric cars.

One of the earliest companies to supply electric light under the provisional order, for the whole of the allotted area, will be the Westminster Electric Supply Corporation. This company has the best districts in London, which includes Westminster, Belgravia, and Mayfair. The central station in Westminster fitted

with Goolden dynamos is almost complete. A temporary station alongside has supplied light to the Houses of Parliament and the mansions about for a considerable period.

The proprietors of the *Manchester Examiner and Times* have lately installed a complete system of electric light in their Manchester office. I am informed that the lighting arrangements have been well carried out by the Manchester Edison-Swan Co.

A few trains running between London and Richmond are supplied with a penny-in-the-slot system of electric light. For the sum of one penny a traveller obtains a good light which lasts for a quarter of an hour.

A *Times* correspondent this morning says that storage batteries have been dispensed with at the Berlin Central Post Office. An accumulator supplied by the Berlin Electric Light Company is used instead.

LONDON, Sept. 15, 1890.

CORRESPONDENCE.

PITTSBURGH.

Putting the Wires Underground.—Electric Railway Notes.—Voting on Electrocution.

THE municipal authorities in this city are going to make a great effort shortly to have all the electric wires now strung along the streets put under ground. The plan so far is to start with police telephone and fire department wires as well as the private lines operated by the city, amounting altogether to 550 miles of wires. For this purpose, the department is going to make an appropriation to defray the cost of the undertaking. Then when these wires are underground, an ordinance is to be offered to councils compelling all the local electric light and street railway companies to put their wires underground also. Superintendent Mead, of the bureau of electricity, has had several interviews already with the chief of the department of public safety, and it is expected that the plans are about formulated which will bring all the wires underground.

The South Side residents of this city are objecting to the Birmingham Traction Company's electric poles, and their opposition became so pronounced a few days ago that the police authorities had to be asked to interfere. It is pleasant to record that this settled the trouble for the time, but it seems extraordinary for people to object to the introduction of rapid transit, especially for those on the South Side of Pittsburgh, who have for years complained that the old horse cars were a nuisance.

According to the popular verdict of a large number of visitors to the Pittsburgh Exposition, it is thought that Pennsylvania ought to introduce electrocution as the most accomplished method of capital punishment. A popular vote on the question: "Should electrocution take the place of hanging for capital punishment in the State of Pennsylvania?" was taken a few days ago and the result was that out of 13,000 visitors, the majority voted "Yes." The peculiar feature in Pittsburgh, however, is that during the last five years, not a man has been executed here at all, not even for the most heinous of crimes.

The latest appliance for simplifying the use of electricity as the motive power on street cars is brought out by a gentleman from Allegheny, who has invented a device whereby the motor and brake power of electric cars may be more easily applied than at present. This device consists of an arrangement which combines the use of the rheostat with the brake. The brake wheel rod is run through the centre of the rheostat and has the spring contact affixed to it in a similar manner as at present. The affair is now being experimented with on one of the electric street cars in this city, and if it is successful, it will be very beneficial to the motor man.

The Duquesne Traction Company proposed to build a tunnel under the Pennsylvania railroad tracks at Penn avenue, near Wilkinsburg, in order to get a direct route from Pittsburgh to Wilkinsburg, a distance of seven miles. The councils of Wilkinsburg have been asked to grant the permission to the Traction company and there is no doubt this will be done.

PITTSBURGH, Sep. 24, 1890.

The Pittsburgh Exposition.—The Allegheny County Light Co.—The East End Electric Light Co.

THERE is no doubt that a great deal of the success of the Pittsburgh Exposition is due to the fact that electricity constitutes one of the attractive features. Then again, it is more than likely that all the other exhibits would be robbed very largely of their beauty were it not that the entire buildings are illuminated with the electric light. There are 1,700 incandescent and 63 arc lights distributed. These are furnished by the Allegheny County Light Company. There are, however, a good many more electric lights, but they are used individually by the Westinghouse and Thomson-Houston Companies. Hughes and Gawthrop, the agents of the latter concern, occupy quite a large space in Mechanical Hall. Here they have displayed a number of incandescent and arc light machines, as well as a motor generator. This generator is of 30 h. p., and it furnishes the power to a number of fans and other small motors throughout the buildings. In a few days it is expected that a number of welding machines will arrive, and the visitors will have an opportunity of viewing the interesting process of welding by electricity.

All the ice-cream eaten at the various stands in the exhibition is made by a machine connected with an electric motor; then there is a cider press also operated by the same means. Owing to the heat from the different engines and boilers, motors attached to fans abound everywhere and the breezes are generally enjoyed.

The Allegheny County Light Company has now a capacity of 35,000 incandescent lamps and 1,000 arc lights, Westinghouse alternating current system, and runs the largest combination central station in Pennsylvania. The company is constantly increasing its capacity, at present at the rate of 1,000 lights per month. The company's plant is in the centre of the city, and another building will have to be added very soon.

The East End Electric Light Company, another corporation operating the Westinghouse system, is also complaining of cramped quarters. Pittsburgh people are certainly very partial to electric illumination, which proves that they know a good thing when they see it. The city has about 250,000 inhabitants and there are now close upon one hundred thousand incandescent and 2,000 arc lamps burning here every night. All the new houses put up, either for residence or business purposes, are also wired for the use of electric lights, and no one thinks any more of putting in gas pipes. A good many of the churches are lit by electricity, as well as the theatres. This, of course, causes the great demand for electric lights and keeps the light companies busy to supply all the demand. The East End Company, which has now a capacity of alternating current apparatus for 20,000 incandescent and 500 arc lamps, increases at the rate of 1,200 lights per month; in fact, the management is now getting ready to devise the plans for an additional power house, giving it space to double the present plant. It is expected to have 25,000 lights going by New Year's eve.

The Westinghouse Electric and Manufacturing Company is adding one of its "Noiseless" motors to the handsome display at the Pittsburgh exposition. The motor will be put on a truck and the whole will add greatly to the interesting features of the exhibit.

PITTSBURGH, Sept. 26, 1890.

CHICAGO.

Northwest Chicago Electric Railway—Plans for Electric Roads at Alton, Ill.

LETTERS of incorporation have been taken out by the Northwest Chicago Electric Street Railway Co. Mr. William Boldenweck, one of the incorporators, states that nothing definite will be decided upon until a franchise has been obtained. The new road is to run through a portion of the city where rapid transit has not heretofore received attention. The electric motors will be operated by means of storage batteries, thus obviating the necessity for overhead wires, and the cars will be similar to those now in use on the West Side cable road. It is proposed to start at the corner of Milwaukee and Western avenues and run north on Elston to Montrose. A branch line will run from Elston avenue along Kedzie avenue to Logan Square, thence down Milwaukee avenue, and another branch will run from Elston avenue along Crawford avenue. The company says it will be ready for business in ninety days from the time it obtains a franchise.

Messrs. Rodgers and Donovan, representing the Holmes street railway syndicate, have been to Alton, Ill., and secured an option on the two street railways between Alton and Upper Alton. If they conclude the purchase, a road will be built to North Alton, and all three operated by electricity.

CHICAGO, Sept. 26, 1890.

DINNER OF THE NEW YORK ELECTRIC CLUB.

This week, on Thursday, October 2, the New York Electric Club will inaugurate its winter season with a subscription dinner, which promises to be a magnificent success. Under the brilliant management of its versatile president, Gen. O. E. Madden, the club has lately been making many steps forward. A great number of its bondholders have been induced by him to cancel the obligations, and thus the debt has been reduced by several thousand dollars. The club finances are, in fact, in better shape than they have been for some time past. Various improvements in the club house and its service have been made, and when the members and their friends sit down on Thursday night they will do so with justifiable feelings of pride in the success of the club as a social institution, for the promotion of hospitality and friendship.

REPORTS OF COMPANIES.

THE NEW YORK PHONOGRAPH CO.

A certificate of the consolidation of the Metropolitan Phonograph Company and the New York Phonograph Company, under the name of the New York Phonograph Company, was filed last week, at Albany, N. Y. The capital of the new company, which equals the aggregate amount of the two companies, is $2,500,000. The trustees of the consolidated company are, John P. Haines, John D. Cheever, R. D. Haines, Noah Davis, William Fahenstock, W. Seward Webb and John L. Martin.

CONSOLIDATED ELECTRIC LIGHT CO.

At the annual meeting of the Consolidated Electric Light Company, held in this city, on September 17th, the following were elected directors:—Hugh R. Garden, Geo. Westinghouse, Jr., Amos Broadnax, Jacob Hays, Thomas B. Kerr, Geo. H. Lewars and John Rooney. At the subsequent meeting of the directors, Hugh R. Garden was elected president; Jacob Hays, vice-president; Geo. H. Lewars, secretary and treasurer. The regular quarterly dividend of 1¼ per cent. was declared payable October 1.

MEXICAN TELEGRAPH CO.

The Mexican Telegraph Company has declared a quarterly dividend of 2½ per cent., payable Oct. 13 to stock of Oct. 4. The operations for the quarter, partly estimated, were:

Receipts June 30 to Sept. 30	$90,618
Operating expenses	16,500
Net income	$74,118
Less dividend Oct. 13	47,815
Surplus for quarter	$26,303
Surplus above dividend July 12	92,072
Total surplus	$118,375
Receipts nine months, 1890	299,576
Receipts nine months, 1889	266,473

Also in treasury 1634 shares Central & South American Company stock, costing $127,886.

CENTRAL AND SOUTH AMERICAN TELEGRAPH CO.

The Central and South American Telegraph Company has declared a quarterly dividend of 1¾ per cent., payable October 6, to stock of September 27. The statement, partly estimated, shows:

Receipts June 30 to Sept. 30	$134,445
Operating expenses	38,000
Balance	$96,445
Less dividend Oct. 6	84,140
Surplus for quarter	$12,305
Surplus June 30 above dividend of July 6	582,459
Total surplus Sept. 30	$594,764
Deduct betterments June 30	286,417
Surplus above October dividend	$308,346
Receipts nine months to Sept. 30, 1890	433,974
Receipts nine months to Sept. 30, 1889	490,663

Eight thousand tons of material for the cable extension to Valparaiso are to be shipped from London, October 8, and the cable is expected to be in operation next January. The $1,000,000 construction certificates, already subscribed for at par, will more than meet the expense. The decrease in receipts for the quarter was caused by unusual receipts in 1889, consequent upon the interruption of the Western and Brazilian cables.

UNITED ELECTRIC SECURITIES CO.

Lee, Higginson & Co. and Parkinson & Burr offer to Thomson-Houston stockholders $1,000,000 of the collateral trust, 5 per cent. sinking fund bonds of the United Electric Securities Co. at 95 and accrued interest, 10 per cent. in the capital stock of the said company as a bonus. The first indenture is down for $500,000 collateral trust bonds, secured by the following first mortgage bonds taken at their par value: Third Ward Railway Co., $39,000; Toledo Electric Railway Co., $50,000; Thomson-Houston Carbon Co., $100,000; Scranton Suburban Railway Co., $9,500; McGavock and Mt. Vernon Horse R.R. Co., $30,000; Peninsula Electric Light and Power Co., $50,000; Jackson Electric Works, $35,000; Jacksonville Electric Light Co., $26,000; Toledo Electric Co., $83,000; Georgia Electric Light Co., $84,000; Palmer Electric Co., $8,500; Hyde Park Electric Light Co., $20,000; Utica Belt Line Street R.C. Co., $25,000; Louisiana Electric Light Co., $66,000. Total, $626,000. The deed of trust provides that the company shall redeem, commencing Aug. 1, 1895, $10,000 bonds a year for five years, in the next five years $15,000 a year and in the succeeding five years $20,000 a year. During the remaining ten years the company shall redeem such an amount of bonds as will retire the whole issue at maturity, Aug. 1, 1920. The bonds may be drawn at 103. The authorized issue of the United Electric Securities Co. is $5,000,000 bonds and $1,000,000 stock, but probably not more than $2,500,000 bonds will be issued. The bonds are $1,000 bonds, and the American Loan and Trust Co. is trustee under trust indenture No. 1. Mr. Thomas E. Proctor is president of the new company, and the following named constitute the executive committee, who will decide upon the bonds to be admitted as collateral for the second series of $500,000, and the subsequent series: Francis Peabody, Jr., Samuel Carr and C. A. Coffin. An important feature of the trust indenture is that no other bonds than those mentioned in the indenture can be substituted, and if any of the collateral bonds are drawn or paid off the money must be used in the redemption of this issue.

BONDS.

La Grange, Ga.—Bonds will be issued by the city to the amount of $50,000 to be spent on the construction of an electric light plant and water works.

DIVIDENDS.

Mt. Carmel, Pa.—A dividend of 5 per cent. has been declared by the Edison Electric Illuminating Company, and a meeting of stockholders will be held November 22 for the purpose of voting for or against an increase of capital stock.

METAL AND SUPPLY MARKET.

REDUCTION IN THE PRICE OF ALUMINIUM.

A special dispatch from Cleveland, O., of Sept. 26, says:—"An announcement of interest to the metal trade is made to-day by the Cowles Electric Smelting and Aluminium Co., of this city. Heretofore the lowest prices made to the public on aluminium in small lots has been $2.50 per pound. The Cowles Co., who are the largest manufacturers of aluminium in the world, issue a circular to the trade to-day cutting this price to $1 per pound for the aluminium contained in any of their alloys. Five years ago, when the Cowles aluminium was first offered for sale, the current price of the metal was $20 per pound, and little if any was obtainable even at that figure, and this without any guarantee of chemical purity. The first price made on the Cowles aluminium was $5 per pound as against the above figure. At $1 per pound aluminium will become a serious competitor with both nickel and tin. At 50 cents pure aluminium would become a formidable competitor with copper."

INVENTORS' RECORD.

Patents issued September 23.

Alarms and Signals:—*Portable Electric Fire-Alarm*, F. R. Upton and F. J. Dibble, 436,961. *Electric Signal for Velocipedes*, C. G. Jiran, 436,979. *Electric Distance Heat-Indicator and Alarm*. F. W. Wiesenbrock, 437,069.

Conductors, Conduits and Insulators:—*Coupling for Electric Wires*, F. R. Jones, 436,857. *Coupling for Electric Wires*, J. J. Hinphey, 437,116. *Underground Electric Conduit*, C. E. Loth, 437,126.

Dynamos and Motors:—*Speed-Regulator for Dynamos*, S. E. Nutting, 436,901. *Commutator-Brush*, C. Wirt, 436,964. *Dynamo-Electric Machine or Motor*, M. Mayer, 437,160.

Electrolysis:—*Process of Electro-depositing Aluminum*, J. A. Jeançon, 436,895.

Heating:—*Electric Heater*, E. Abshagen, 436,864.

Lamps and Appurtenances:—*Electric-Arc Lamp*, A. Wagniere, 436,814. *Holder for Electric Light Shades*, L. J. Atwood, 437,008.

Medical and Surgical:—*Electro-Osteotome*, M. J. Roberts, 436,804. *Electric Belt*, L. D. Ashbrook, 437,079.

Miscellaneous:—*Electric Controller for Power Mechanisms*, R. D. O. Smith, 436,843. *Electrical Weighing Machine*, W. Snelgrove, 436,910. *Thermal Cut-Out*, G. H. Whittingham, 436,952. *Artificial Resistance*, E. M. Bentley, 437,011. *Method of Impregnating Parts of Electrical Apparatus*. F. L. Rawson, 437,044. *Rheostat*, J. H. Gunning, 437,111. *Nautical Magnetic Tracer Apparatus*, F. Aramburu, 437,169.

Railways and Appliances:—*Mechanical and Electrical Railway-Signal*, B. R. Davidson, 436,777. *Electric-Motor-Car Truck*, E. W. Goss, 436,779. *Electric Contact Device*, J. J. Hoppes, 436,874. *Electric Railway*, H. W. Libbey, 436,923. *Electric Railway*, R. M. Hunter, 437,158.

Telephones and Apparatus:—*Telephone-Exchange System*, E. M. Bentley, 437,010 and 437,012.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

ALEXANDER, BARNEY & CHAPIN.

From the way things have started there is every promise that the fine store at 20 Cortlandt street of this popular new supply house will soon become known as the "Down-town Electric Club." It is at the very heart of things electrical, and, although the store does not open until October 6, there is already an incessant influx of callers and visitors. One feature of the scene is that the guests of the concern belong to all branches of the profession and industry. This, however, is not to be wondered at in view of the prominence of the members of the firm in their late respective fields. In fact, the unsolicited influx of well-wishers has already been so great that Mr. Alexander has set aside a very cozy corner of the store as a kind of correspondence and exchange room. It will be fitted up in a social, clubbable way, and anyone coming to town or desiring to meet a business friend down town will be fully at liberty to make himself at home there, not only leaving his baggage there, but also receiving his mail and telegrams at the same headquarters. A convenience of this nature has long been needed for business purposes in electrical work, and there is every probability that the A. B. C. store will soon become in this manner an Electrical Exchange at the midday hour. At any rate, Mr. Alexander will address his energies and talents to that point, and with the help of his able colleagues he bids fair to succeed to admiration.

The store will be about ready this week, and in the meantime a large amount of work has been done in mapping out departments, fitting up, upholstering, disposition of stock, etc. A little delay and difficulty has arisen from the desire of a large number of individuals and companies to place their product in such good hands.

ELECTRICAL FEATURES OF THE PITTSBURGH EXPOSITION.

ONE of the most important and interesting features of the Pittsburgh Exposition is that made by the Westinghouse Electric and Manufacturing Co., whose mammoth establishments are situated in that place.

As the pioneer and chief promoter of the alternating current system of electric lighting, the company confines itself simply to a display of alternating current apparatus, and it is safe to say that no other electrical concern, either in this country or in Europe, has made a show so manifold and so complete in its illustration of the development of the alternating current system.

On entering what is known as Mechanical Hall of the Exposition building, the display of the Westinghouse company occupies the entire view on the right hand side, and one of the first pieces of machinery is a 3000-light alternating current dynamo, belted to a rotary engine of four hundred horse power. The latter was designed and invented by Mr. George Westinghouse, Jr., and its peculiar shape and appearance for a steam engine attracts great attention. Next to the large arc apparatus is another of 1500 lights capacity, belted to a Westinghouse compound engine. Then follow all in a row a 750-light dynamo, belted to a Westinghouse Junior engine of 60 horse power; a 2000 volt, self-exciting machine of 1000 incandescent lights, also belted to a Westinghouse Junior engine; a 25-light alternating current arc machine, attached to a Westinghouse Standard engine, and at last, a 30 horse power arc motor generator, also belted to a Westinghouse Standard engine.

In the evening, all the apparatus and the engine are in operation. The incandescent machine generates the current for all the lights used in and about the building. The 3000 light dynamo, however, is operated exclusively to light up an illuminating sign, which is put up in the form of an immense arch on the grounds surrounding the Exposition. This arch carries the following lettering on both sides: "Westinghouse—Pioneers of the Alternating System."

The two signs contain over 2000 incandescent lamps of 16 candle power each, and their effect in the evening gives a very good idea of the artistic capabilities of electrical illumination.

The other light machines operate the lights throughout the buildings as well as those utilized in the display. The arc dynamo operates the well known flat carbon lamps, of which the Westinghouse Electric and Manufacturing Company are the makers.

The arc motor generator operates about a dozen Tesla and other arc motors, and if any one is desirious of having proof of the commercial usefulness of the Tesla motor, he can have it in this exhibition. For light manufacturing purposes, especially, there is claimed to be no motor superior. In this display, one motor operates a small printing press, several of them operate fans, while in one part of the exhibition another runs a carpet loom, again another, a stone crusher, a third rotates a six foot circular saw, a fourth the Hercules mining machine, a fifth operates a soap wrapping machine and a caramel wrapping machine of the Nuttall Manufacturing Company.

Adjoining the motor generator is a pavilion handsomely furnished in antique oak, decorated with tropical plants and draped in the most elegant and tasteful manner. In a corner of this pavilion stands a Domestic sewing machine, fitted up with a new type of alternating current motor, brought out not long ago by the Westinghouse company. The peculiarity of this motor is that its brushes are utilized as a regulator of the speed of the motor. This method of regulation is operated by the treadle of the sewing machine, the harder the treadle being pressed the lower will be the speed. The working of the apparatus is constantly explained to the many interested housewives who are crowding around the pavilion all day long.

In front of the pavilion stands an experimental table filled with all kinds of peculiar contrivances of the alternating system. There is the Shallenberger meter, the converter, a stage regulator and a number of motors, the smallest one having only sufficient power to blow out a match. An electrician of the company is constantly in attendance here for the purpose of illustrating the workings of the different appliances. He shows the action of the meter when attached to one lamp, ten lamps, up to 50 lamps. He explains the street converter system. He shows the manner in which the stage regulator operates. The latter is connected with five switches, each controlling ten lamps.

Altogether the display is one of the most wonderful that has ever been gotten up for any exhibition.

It has not only been the object of the company to prove to the visitors that Pittsburgh stands to-day unrivaled in the electrical industry of the world, but the company is also anxious to explain to everybody who cares to learn, the intricacies and wonders which are constantly confronting the uninitiated in electrical science.

NOTES ON MINNEAPOLIS INDUSTRIAL EXPOSITION.

Westinghouse, Church, Kerr & Co. show three of the Westinghouse engines in operation, a "Standard" automatic, compound automatic and "Junior" automatic. These engines run very nicely and attract a great deal of attention on account of the small floor space they occupy. The exhibit is in charge of Mr. W. O. Everett and his assistant, Mr. S. J. Reed, is running the engines.

The Northwestern Thomson-Houston Company are also making a very fine exhibit, and doing the largest part of the lighting for the Exposition. They have in operation four Thomson-Houston arc machines of 50-light capacity each, two alternating incandescent machines, one of 1,300 lights and the other of 650 lights, a direct current machine of 60 h. p., run at a pressure of 250 volts; used for generating current to operate motors.

Cooley & Vater exhibit, among other specialties for power work, a 300 h. p. Weisel and Vilter Corliss engine which has a cylinder 20x42 and runs at 86 revolutions per minute under 100 lbs. steam pressure. This engine is employed to run a line of shafting to which are belted four Thomson-Houston 50-light arc machines, one Brush 30-light arc machine, one 1,300, and one 650-light alternating machines.

The Interior Conduit and Insulation Company make a very handsome showing of their interior fireproof insulating conduit tubes for house and underground use. This is one of the most useful systems that could possibly be devised and has found immense favor among electricians by reason of its flexibility as regards the system of wiring and its safety. It is also coming rapidly into use in underground work, and over 150 miles are now being used in Minneapolis and St. Paul for the electric street railways. Samples of the underground system and all the various tubes for interior building wiring are on exhibition.

W. S. Nott has a piece of the leather belting manufactured by him for the Minneapolis Street Railway Co. which is no less than 75 inches in width and which is claimed to be the widest leather belt in the world.

One of the most interesting and thoroughly practical exhibits shown is that of the Thomson Welding Company. There are several different sizes of welding machines shown in practical operation, and welds are made in the finest wire up to heavy bars of iron and steel. The sample boards shown present some very remarkable combinations of the various metals which are capable of being welded together by this method, and articles of all shapes and sizes can be turned out. The space of time occupied in making the weld is very short. Insulated wires can be welded together without injuring the insulation, which it is only necessary to strip off right at the point of junction.

The Carpenter-Nevens Electro Heating Co. are making a very handsome exhibit of the application of electricity to heat sad irons, soldering irons, stamps, cooking utensils, and numerous other devices. They appear to have got this method to a state of perfection which has not heretofore been reached. Their apparatus is very handy and convenient, while the amount of current absorbed is small, as all their apparatus is so constructed that the heat evolved from the resistance is concentrated upon the parts to

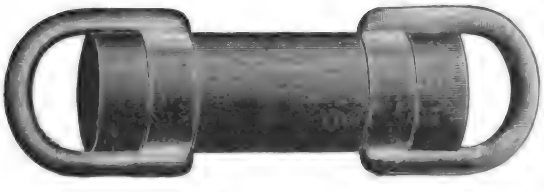
be heated, a very small percentage being lost in heating the surrounding atmosphere.

One of the most striking applications of the phonograph is shown by Mr. A. Theo. E. Wangeman, in the Art Gallery. A phonograph is connected with a long distance telephone instrument and music or talking emitted from it is sent over the telephone line, and can be heard by placing the receiver at the other end of the line to the ear with the greatest distinctness and accuracy. It is possible to connect all subscribers so that they can hear at the same time with their instruments, and it will, ere long, save them the trouble of going to church or the opera.

The Edison Co. make a large exhibition of their underground tube system which has been successfully in operation for many years. Various sizes of the 3-wire feeders and mains are shown with junction boxes and all the parts of the system, making a very fine exhibit.

ENGLUND'S CENTRE CURVE INSULATOR.

The insulator shown in the accompanying cut is for use where unusual strains have to be met. The managers of the Electric Merchandise Company, Chicago, who are the owners of this patent, have, during the last few years, experimented very largely with a view of securing a centre curve insulator which, while being neat in appearance, would have the requisite strength needed for all demands. The objection offered to those heretofore made has been that, to get the needed strength, it has been necessary to have the insulator so heavy that it has been unwieldy to handle, and heavy in appearance on the line; while if attempts



ENGLUND'S CENTRE CURVE INSULATOR.

have been made to lighten it, openings have had to be made, which, filling with rain and snow, have destroyed the insulation.

The insulator illustrated is a solid but very neat coil of rubber, but nine inches in length, and when placed on the line, it is scarcely discernible. It is, however, protected on the inside of the rubber so securely that it will stand any strain which may be put upon it, even to holding the extreme ends of the line.

RAPID CENTRAL STATION CONSTRUCTION IN CHICAGO.

One of the most remarkable feats in the rapid construction of a central station has recently been accomplished in Chicago by Mr. W. H. Harding, manager of the South Side Electric Company, in building and completely equipping the company's new station at Twentieth and State streets, from laying the boiler foundations to the lamps, in the space of exactly fourteen days.

The plant now installed comprises two boilers and two high-speed automatic Bass engines of 100 h. p. each, running at 265 revolutions per minute, which drive two 1,000-light Slattery alternators and one 25-light Wood arc machine. With the boiler plant is installed a 200 h. p. Kroeschell feed heater and a duplex Deane pump. The new Alhambra Theatre is lighted from this station; and the illumination and regulation of the lamps has been effected in a very neat and effective manner, the decorative effects being particularly striking. Mr. Harding has been ably assisted in carrying out this work by Mr. F. L. Webster, his superintendent, and it is due to their united and indefatigable efforts that the work has been so expeditiously and thoroughly done.

PROSPERITY OF THE GREAT WESTERN ELECTRIC SUPPLY CO.

So phenomenally rapid has been the growth and extension of the above company, some people have, perhaps not unnaturally, supposed that it must be doing a business far beyond its pecuniary resources, and it was possibly in this way that unfavorable rumors were recently set in circulation as to the financial standing of the concern. With the very wise determination to nip in the bud any talk that might thus be injurious to them by affecting their credit and checking the influx of orders, Mr. George Cutter, the able general manager of the company, has come out with a flat-footed, categorical denial of the reports. He says that they are altogether unwarranted and utterly without foundation. The more positively to put a summary end to such rumors, Mr. Gilman, the energetic president of the company, has paid out during the last few days over $110,000, anticipating in fact many of the claims still to come due on them. It has been and still is definitely the intention of the company to buy large quantities of goods of all kinds for spot cash, thereby taking advantage of the very favorable terms which can thus be obtained. Mr. Cutter has a list of merchandise, for example, to be purchased in this manner aggregating over $130,000.

RAPID CONSTRUCTION FOR THE ELMIRA, N. Y., ELECTRIC RAILWAY.

A REMARKABLE feat of electrical railway construction has recently been completed at Elmira, N. Y. On the 30th of July the Elmira and Horseheads Railway Co. placed a contract with the Edison General Electric Company for the equipment of seven thousand feet of track, six motor cars, and a full station equipment. At the same time, a contract was placed with the John Stephenson Car Company for six new cars of solid and elegant construction. The contracts were made, in both cases, with the strong guarantee that the roads should go into operation on September 1, in order to be ready for the Great International Fair which was to open on that day. Both the Edison Company and the Stephenson Company put their best men upon the work, and forwarded supplies with the utmost possible despatch. On or about the fifteenth day of August the Stephenson Company announced that its cars were ready for equipment, and at about the same time, the motors were shipped from the great Schenectady Works of the Edison Company, which have a capacity of from 15 to 20 street car motors per day. The strike on the New York Central at this time bid fair to cause very serious delays as the cars were to be equipped in New York. A special consultation between the Edison Company and the Stephenson Company was held at Schenectady, with the result of causing the motors to be shipped via the Delaware & Hudson R. R., and the Delaware, Lackawanna & Western R. R. Companies, a round-about route, which necessitated special cars and unusul expedition. On about the 20th of August the completed cars began to go out from the Stephenson factory, two being shipped each day. In the meantime a contract had been placed with the Simplex Company, of Boston, for the feed wire, the Edison Company had forwarded all line material and supplies, and everything was on the ground but the poles, which were held in Northern New York awaiting arrival of cars that had been delayed on account of the New York Central strike. In this emergency every one turned in to help. Poles were gathered around Elmira, and at 12 o'clock on the night of August 23d, the street construction work commenced. Provision for the dynamos and appliances had been made by engaging a part of the Westinghouse station at Elmira. On August 31st notice was sent to the Railway Company that the road would begin operation on the following morning, and promptly at 6 A. M. on the first day of September, the road carried its first passengers. For the next few days the strains on the new machinery were excessive, the cars frequently having to carry two loaded trailers, and to remain in service from early morning until late at night. The number of passengers carried by these electric cars, with their complement of trail cars, in a day, was over twenty-five thousand. The road was entirely satisfactory in every respect, and Col. Robinson and Messrs. I. B. Newton & Co., the present owners of the road, have every reason to be grateful to both the Stephenson and the Edison Companies for this phenomenal execution of a time contract.

CONSOLIDATED ELECTRIC STORAGE CO.

Mr. Henry C. Whitney, late of the Crosby Electric Co., has been appointed the Superintendent of Agencies, by the Consolidated Electric Storage Co., and his office address will be at 120 Broadway, this city.

RECENT EDISON STREET RAILWAY CONTRACTS.

Among the recent railway contracts closed by the Edison General Electric Company may be mentioned the following: The Minneapolis, Minn., Street Railway Company; The Savannah, Ga., Street and Rural Resort Co.; The Dallas, Tex., Consolidated Traction Co.; St. Johns, N. B., City Railway Co.; James Street Belt Line Railway Co., of Seattle, Washington; St. Paul, Minn., City Railway Co.; Tacoma, Wash., Railway & Motor Co.; Richmond, Va., City Railway Co.; Utica and Mohawk Railway Co., of Utica, N. Y.; Elmira and Horseheads Railway Co., of Elmira, N. Y.; Elgin, Ill., City Railway Co.; People's Street Railway Co., of Scranton, Pa.; Fort Scott, Kan., Railway Co.; Louisville, Ky., Railway Co.; Pittsburgh, Pa., Railway Co.

The Edison Company is doing a large amount of foreign business, one of its recent contracts being for the equipment of the St. Johns City Railway Co., of St. Johns, New Brunswick, which is one of the strongest roads in the Dominion. The contract was closed through Mr. John F. Zebley, of New York, the president of the road, and the Edison system was determined upon by Mr. Zebley after a most thorough and careful examination of the different railway systems in this country.

THE DETROIT MOTOR CO.

The Detroit Motor Company have about completed their magnificent new factory in Detroit, situated on Cass avenue, beside the Michigan Central tracks. The ground occupied by them is 2½ acres in extent, giving them ample space for one of the largest electrical factories in the country, and we opine it will not be long before they add new buildings to the present. Their new factory has a frontage of 100 feet and is 250 feet deep. It has been completely built and equipped in two months. It is entirely illuminated by a special electric light and power plant, all the machinery being directly operated by motors.

The front portion of the building is three stories high. On the ground floor are the offices and motor room, and in a large one-story extension is the machine shop, fitted with the latest and most approved machinery. The second floor comprises stockroom, brass finishers' room and winding room for small work, and on the third floor is the main winding room. The Hon. Wm. C. Maybury is president, Mr. F. A. Blades, secretary and treasurer, and Mr. Henry H. Blades, the inventor of this excellent motor, electrician.

"ELECTRICITY IN DAILY LIFE."

The series of electrical articles that has been a leading feature of *Scribner's Magazine* for some time past, is brought to a conclusion this month with the appearance of an admirable sketch by Mr. H. L. Webb, of the details and incidents connected with laying an ocean cable. It is in fact one of the most interesting of the series, and is certainly one of the best written. The following important announcement has just been issued by Charles Scribner's Sons:—"The electric articles, which have attracted wide popular interest during their appearance in *Scribner's Magazine*, have been collected into a handsomely printed volume which presents a clear and adequate account of the applications of electricity to the needs of modern life. The ten writers of these papers were selected for their eminence as acknowledged authorities in various fields, both as theorists and practical electricians. They include the Patent Attorney for the Western Union, Edison's Chief Electrician, the President of the Stevens Institute, the Professor of Physics at Princeton, the Editor of The Electrical Engineer, and other prominent experts—all of them men who possess the faculty of imparting information entertainingly. The volume is profusely illustrated by the best artists and engravers. The work will give to the non-technical reader a definite idea of a group of new industries, already employing about 300,000 men and millions of capital." This volume will appear under the title of "Electricity in Daily Life," and will undoubtedly enjoy a wide circulation.

THE JOLIET, ILL., ELECTRIC STREET RAILWAY.

The Joliet Electric Street Railway Company, which has adopted the Thomson-Houston Electric Railway System, completed the electrical equipment of its road, and was put in operation on Feb. 3d, 1890. It is four miles in length, and part of it is built with bracket suspension, and the remainder with the cross suspension method. The overhead line is built upon 30 feet cedar poles, tastefully painted. It has a number of difficult curves, crossings and switches, for which the overhead line is arranged, and, since starting, it has had an exceedingly heavy traffic, but has been in constant operation without the slightest delay or trouble. They are at present operating 9 motor cars, each equipped with two 10 h. p. railway motors. The power station is equipped with two 80 h. p. Thomson-Houston generators, with switch-board fitted with all the necessary appliances for the manipulation of the current. The management of this road is so well pleased with its operation that they have placed orders with the Thomson-Houston Electric Company for additional equipment. It is a saying with the citizens of Joliet, that the Joliet Electric Railway Company's cars are "always on time."

STANLEY & HALL.

At a meeting of the board of directors, Sept. 20, it was decided to change the name of the corporation from Hazazer & Stanley to Stanley & Hall, by which it will now be known. It is understood that Mr. E. W. Hazazer is going West. Mr. A. F. Stanley, president and general manager, will continue in active charge of this progressive business.

A UNIQUE SWITCH

Embodying many new features will be brought out by The Great Western Electric Supply Co. in about ten days. It works on a new principle, and judging from the rumors which have been circulated during the past month, is destined to create a sensation in switch circles. The same firm is also getting a new fire-alarm system ready for the market. This is said to possess many advantages over the release-key system now in general use, and will probably find special favor in small towns.

THE PATTEE LAMP HOUR RECORDER.

The Great Western Electric Supply Co. write us that their orders on Pattee lamp hour recorders have outrun the capacity of production, and that they will have to strain every nerve to catch up.

HERING & DAVIDS.

The above firm have established themselves at 308 Walnut street, Philadelphia, as consulting electrical engineers, and make a specialty of testing dynamos, motors, batteries, etc. They also make examinations and reports of inventions; deliver expert opinions and testimony in patent causes, and undertake the calibration of instruments. They confine themselves to technical work as distinguished from contracting, but draw plans and specifications for, and supervise the erection of, any electrical work.

BARAGA FOR BATTERIES.

Several shipments of baraga have been made from an island near the north shore of Lake Superior recently. It is a clay-like mineral used in pottery ware and for foundry facings, but electrical experts at Detroit have found a new use for the mineral that will have a bearing on the production of electricity. The clay, as it comes from the ground, when placed in a cell with common brine, and the usual amount of zinc, produces a two-volt E. M. F. After three months the baraga is dissolved and then it is found to be pure graphite and more valuable than before using. A $200,000 stock company has been formed at Detroit.

WESTERN TRADE NOTES.

Mr. Pulsifer, of the Mather Electric Company, is in town for a few day looking after his company's interests here.

Mr. L. W. Magee, formerly with the Thomson-Houston Company, has accepted a position as general sales agent of the Excelsior Electric Company.

Mr. Walter J. Floyd, till recently general sales agent of the Excelsior Electric Company, has accepted a similar position with the Sperry Electric Company.

The Ft. Wayne Electric Company, through their Chicago office, have just sold a 1,500 light Slattery induction system plant at Atlantic, Ia., for street and commercial lighting.

The Electric Merchandise Company, 11 Adams Street, Chicago, have issued a very handsome little circular setting forth the many advantages of their improved rawhide pinions for armatuer and intermediate shaft. Their business in electric railway supplies, to whch line they devote their exclusive attention, is increasing all the time, and they find it hard work to keep up with their numerous orders which come in from almost each and every electric street railway company in the country. Mr. Mason is a most able and courteous manager and certainly deserves the magnificent success he has made of so recently organized a business.

NEW ENGLAND TRADE NOTES.

The Standard Electric Company, of Vermont, have sold a 100 light dynamo to the Evans Artificial Leather Company, Salem, N. H.

Mr. A. E. Davis has opened an office at 620 Atlantic avenue, Boston, and will look after the interests in New England of our esteemed contemporary, *Electric Power*.

Mr. C. W. Cartwright, a gentleman well-known to the electrical fraternity, has issued invitations for the occasion of his marriage to Miss Lottie Jane McKenney, on October 8th, 1890. Mr. Cartwright has the good wishes of his numerous friends in the electrical business.

The American Circular Loom Company, of Boston, have issued a neat little pamphlet giving the price of their patent woven insulated wires and cables, with several interesting reports of tests by eminent authorities on the insulating and abrasion resisting qualities of their covering. The booklet contains a few useful tables of weights and sizes of wires, and forms a very convenient memorandum book for purchasers of insulated wires.

A. W. Whitcomb, Worcester, Mass., is making a specialty of the manufacture of electric motors and dynamos, and is making quite a success of them. Mr. Whitcomb has had a long experience in mechanical engineering and is now connected with one of the largest machine shops in Worcester, so that he brings a thoroughly practical mind to bear on the electrical problems. The motors and generators are simple, well constructed, and compare very favorably with those of other manufacture in general appearance and in tests of economy and efficiency.

Departments of Lighting, Power, Electric Railway, &c., will be found in the advertisement pages.

THE

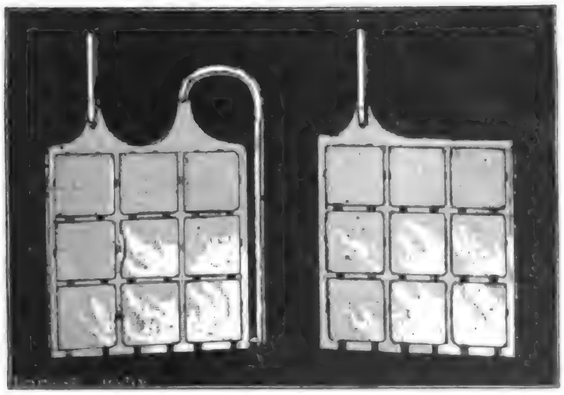
Electrical Engineer.

Vol. X. OCTOBER 8, 1890. No. 127.

THE SYSTEM OF THE ELECTRIC STORAGE BATTERY CO.

FOR some time past there has been operated at Germantown, Pa., a storage battery station deriving current from generators situated at the station of the Germantown Electric Light Co., and distributing it to lamps in the immediate vicinity in stores and dwellings, as well as operating a number of motors. This plant consists of 512 cells in 8 series of 64 each and has a capacity of 1,600 ampere hours. The results obtained in this plant have been so satisfactory and the arrangements adopted for proper regulation are of so simple a nature, that a more detailed description of the system will not fail to interest our readers. We may remark here that the greater part of the apparatus has been designed by Mr. Stanley C. C. Currie, the electrician of the Electric Storage Battery Co., of Philadelphia, and all parts involve novel features.

We propose to begin with the storage battery and its method of manufacture, which is now being regularly carried on in the company's factory at Gloucester, N. J. The results of numerous experiments have shown that the spongy lead reduced from different lead salts has a varying structure and consistency and that the number which can be employed for battery purposes is limited. This subject has been very carefully studied by the company and the conclusion arrived at is that the lead reduced from the chloride possesses the best properties for battery



Figs. 1 and 2.—Cast and Finished Grid.

purposes. In order to obtain a cheap and homogeneous product, however, certain precautions are necessary in manufacture. To obtain the chloride, commercial lead is melted and converted into a finely divided form by a special process. The finely divided lead is then dissolved in nitric acid and is then precipitated as chloride of lead by the addition of hydrochloric acid.

The white chloride of lead so obtained, after being thoroughly washed and dried, is mixed with a certain proportion of chloride of zinc and the mixture brought to a molten state in a furnace. The fused mixed chlorides are then poured into square molds and allowed to cool and crystalize. The square blocks of chloride so formed and which are destined as the active matter in the plates are then placed in a mold prepared for their reception and a grid of lead cast around them, binding the blocks into a compact plate, as shown in Fig. 1.

The method usually employed for making the lead grids of storage batteries consists in pouring the molten metal into a suitable mold. In the present instance, however, an improved method is employed, which not only effects great economy in time but brings the lead in inti-

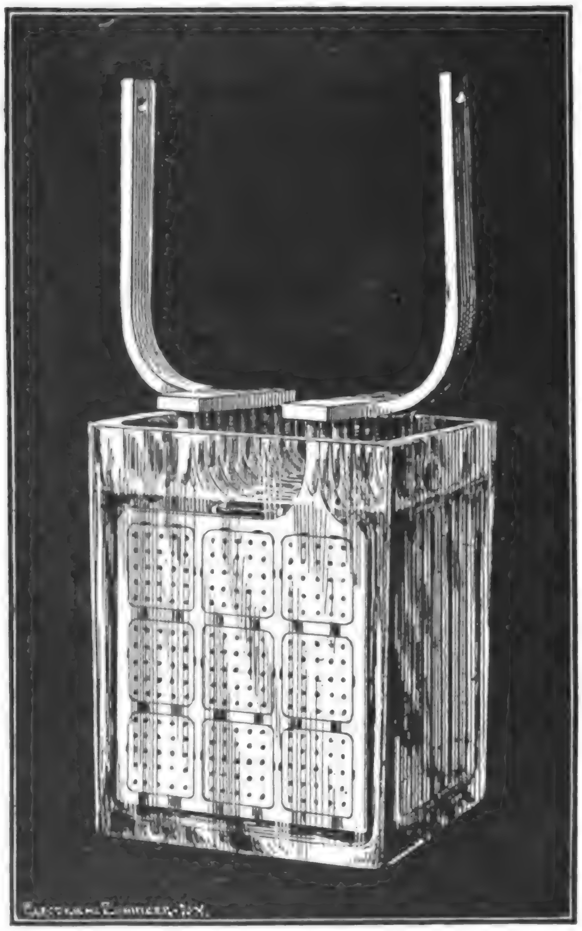


Fig. 4.—The Complete Cell.

mate contact with the blocks of chloride. This is accomplished by forcing the molten lead around the blocks under pressure. Our engraving, Fig. 3, shows the room in which the plates are prepared, with the casting press against the rear wall. The mold with the chloride blocks in position is placed in the press and connected to the lead outlet by a simple coupling. By the turn of a handle the lead is forced through the outlet into the mold and around the chloride blocks, gripping the latter tightly. When taken from the casting mold, the grid has the appearance shown in Fig. 1, being provided with a curved extension by which it can be conveniently handled for the subsequent operations.

The grids in their present condition are now packed between zinc plates and placed in a tank containing a dilute solution of chloride of zinc. There is thus formed a voltaic couple the action of which is to dissolve the zinc chloride and to extract the chlorine from the lead chloride contained in the blocks, thus leaving the lead sponge in their place. The last trace of chlorine is removed from the plates by washing and then placing them in a tank con-

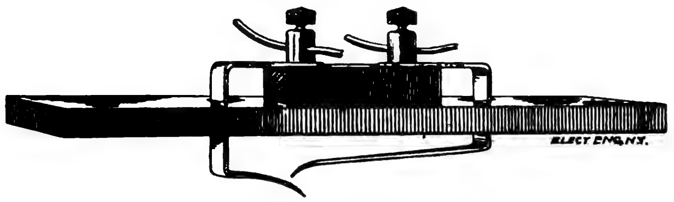


FIG. 5.—FULL CHARGE INDICATOR.

taining nitric acid, and passing a current through them. This action also opens the pores and leaves a pure lead sponge in the grid. The plates intended for the anodes or positives of the batteries are then packed tightly between perforated ebonite boards and formed into peroxide in dilute sulphuric acid.

The finished plate is shown in Fig. 2. The standard cell shown complete in Fig. 4, consists of 9 positive and 10

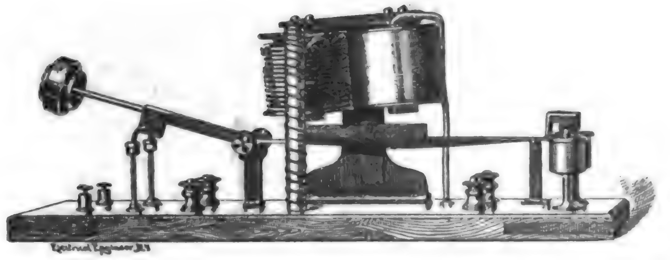


FIG. 6.—AUTOMATIC BATTERY CUT-OUT.

negative plates, having a capacity of 230 ampere hours and weighing, complete, 34 pounds. This gives as a result a capacity of 9.9 ampere hours per pound of plate and 18 ampere hours per pound of total active material. In size the plate is 5¾ inches wide by 6 inches high.

In the special street car cell of 1·9 plates the weight of active material and of the grids is, respectively, 12½ and 10⅝ pounds.

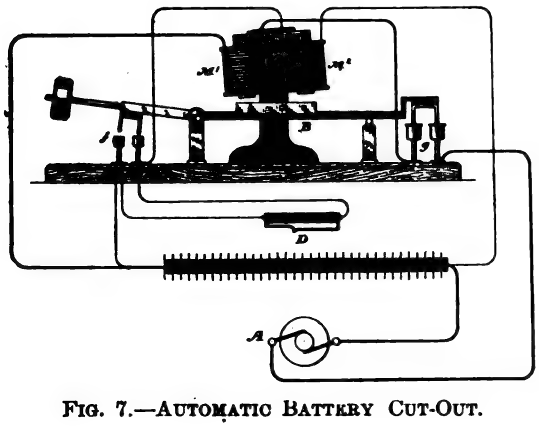


FIG. 7.—AUTOMATIC BATTERY CUT-OUT.

Next to a good storage cell itself, its regulation is of the utmost importance in a battery installation, not only to avoid rapid deterioration of the cells themselves and to prevent the destruction of the dynamo by reversing, but also to insure constant potential on the leads in order to secure uniform brilliancy and long life in the lamps.

The devices designed by Mr. Currie and employed in the Germantown station are designed to take care of all these points, and we will begin their description by noticing an ingenious little device for indicating in a prominent way the moment when the battery is fully charged.

It is well known that, when fully charged, storage cells begin to "boil," due to the rapid development and escape of gas. This creates a spray of the acid which is projected upward a short distance from the surface of the liquid in the cell. Mr. Currie utilizes this property by placing over the top of the liquid the device illustrated in Fig. 5. This consists of an ebonite block provided with terminals to which are connected two lead strips shaped in the manner shown, connected to the terminals of some indicating device, such as a vibrating bell and battery.

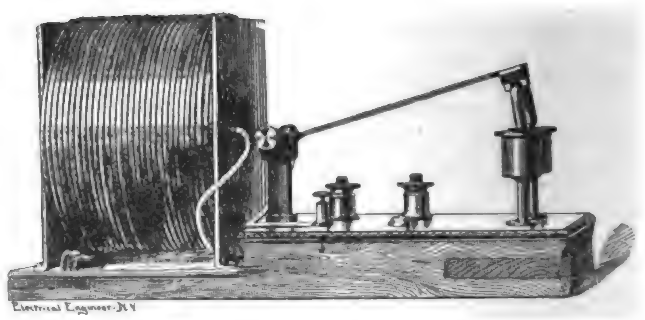


FIG. 8.—AUTOMATIC CUT-OUT FOR PREVENTING REVERSAL OF POLARITY.

Under normal condition this bell circuit is open, being broken at the point separating the two lead strips in Fig. 5. But as soon as the battery becomes fully charged the spray thrown up accumulates on the upper strip and forms a drop which flows down towards the point and bridges the gap between the two strips. This immediately closes the indicating circuit, and rings the bell which notifies the attendant of the fact.

This simple device is, however, used in connection with an automatic cut-out which makes the presence of an attendant unnecessary and which we now propose to describe. This apparatus which is shown in the engraving,

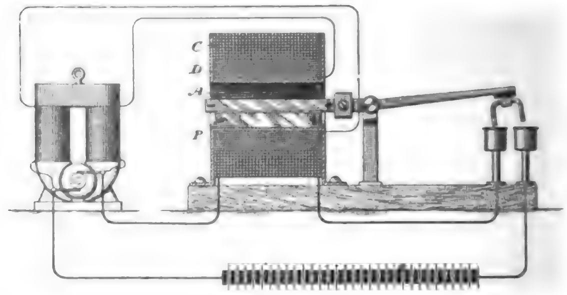


FIG. 9.—AUTOMATIC CUT-OUT FOR PREVENTING REVERSAL OF POLARITY.

Fig. 6, is designed to automatically throw the batteries into the generator circuit when their potential has fallen to the limit allowable, and, on the other hand, to automatically cut them out of circuit when fully charged, or when the current exceeds the normal charging rate. The cut-out, the operation of which is shown diagrammatically in Fig. 7, consists of an electro-magnet, one leg of which is wound with coarse wire M_1 and which is placed in series with the dynamo A and batteries, the circuit passing through the mercury cups g. The other leg of the magnet, consisting of fine wire M_2, is connected to the terminals of the battery through the mercury cups f. To these cups also are connected the terminals of the cut-out device described above, which is indicated at D.

The operation will now be readily understood. When the normal current is passing into the cells the connections are as indicated in Fig. 7, with the armature B unattracted by the magnet, the current only passing through coil M_1. Any excess of current above the normal, however, causes the armature B to be raised, breaking the main charging circuit at the point *g*. At the same time, however, it closes the circuit of coil M_2 at *f*, causing the armature to be permanently attracted and keeping the main circuit open. The employment of the two coils is necessary, since it is evident that the breaking of the main circuit de-energizes the coil M_1. The maintenance of an abnormally high current in charging the cells is thus avoided.

To effect the cutting out of the battery when it is fully charged the device shown in Fig. 5 and indicated at D, is employed. The formation of a drop by the accumulation of spray closes the circuit of coil M_2 in the same way as if the point *f* were bridged, and causes the armature B to be raised, so as to break the main circuit in the manner just described. In this way overcharging is prevented.

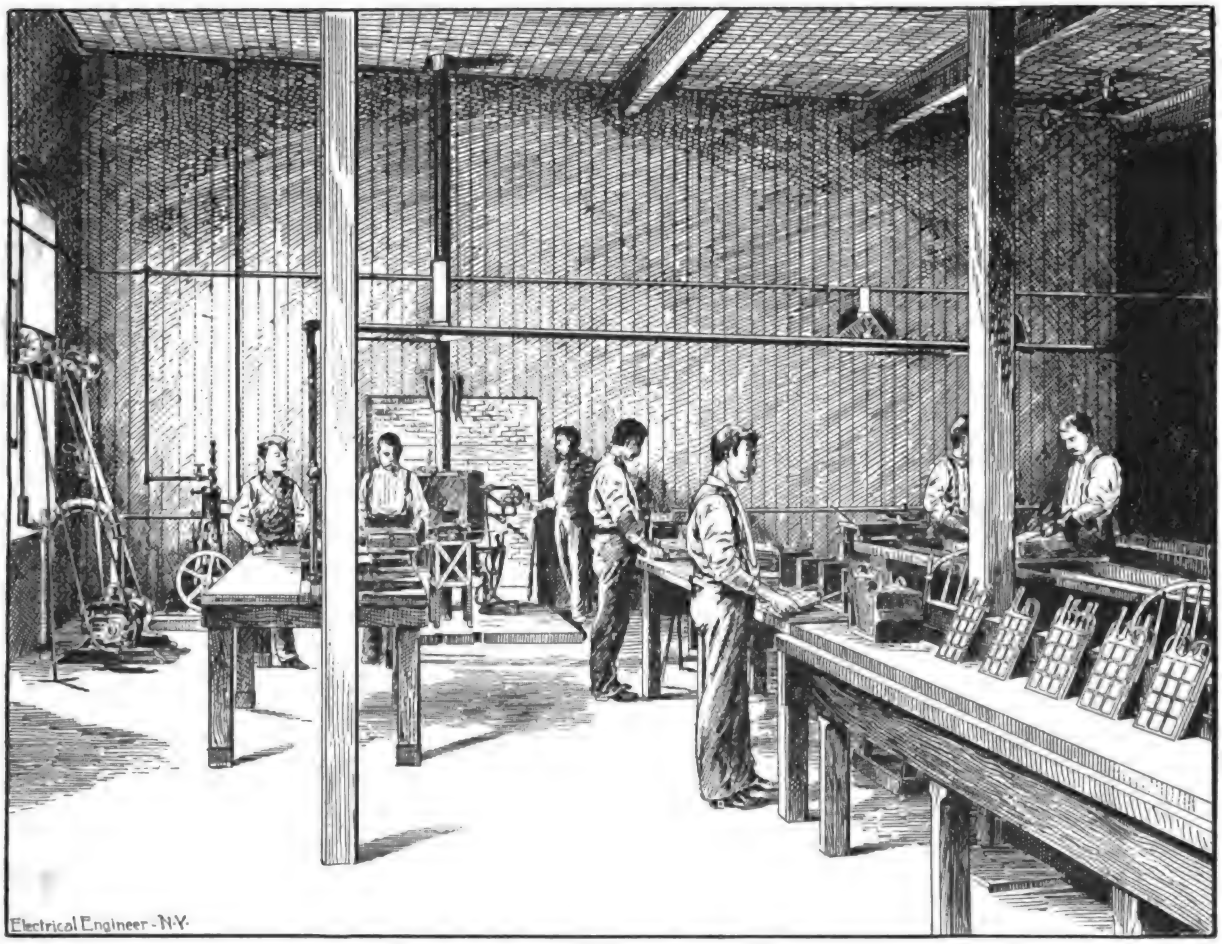


FIG. 3.—GRID CASTING ROOM IN THE ELECTRIC STORAGE BATTERY CO.'S FACTORY.

In storage battery installations provision must also be made against a reversal of polarity in the circuit which would tend to send current from the battery into the dynamo, and tend to reverse its action by driving it as a motor, or possibly burn it out, if the current be heavy, besides draining the battery of current.

To avoid such a reversal of polarity, therefore, Mr. Currie makes use of the cut-out illustrated in perspective in the engraving, Fig. 8, and the action of which will be readily understood by reference to the diagram, Fig. 9. The apparatus consists of a solenoid wound with two coils; one of these, of coarse wire C, is placed in direct circuit with the batteries, and the other, of fine wire D, in circuit with the shunt field of the dynamo.

Within the hollow of the coils there is fixed a permanent bar magnet P covered with a sheet of brass and immediately above it is pivoted a movable core A of soft iron, and having a counterpoise which tends normally to hold the armature close to the magnet P. The opposite end of the rocking arm carries a fork which dips into mercury cups placed in the battery circuit.

The object of the apparatus is evidently to complete the main charging circuit when the electromotive force of the dynamo exceeds that of the accumulator, and to maintain this position as long as their relative condition remains unchanged, and promptly to open the main circuit and thus cut out the dynamo whenever the electromotive force of the accumulator exceeds that of the dynamo, thus preventing the injurious action of reverse currents.

When no current traverses the coils C D, the armature A is normally attracted by the permanent magnet P and held close thereto. This lifts the forks and breaks the main circuit, as shown. Now, when the dynamo starts, as soon as its electromotive force rises to the requisite intensity in excess of that of the battery, the fine wire coil D, being properly wound for that purpose, creates in the armature A magnetism similar in polarity to that of the permanent magnet P. The armature, consequently, is repelled by the magnet and forced to the opposite side of the cavity in the coils. The intensity of the field-magnets, or, in other words, the electromotive force required to do this work, can be regulated by adjusting the counterpoise. This repulsion of the armature closes the main circuit by inserting the forks in the mercury-cups. As the coarse coil C, which is included in the main circuit, is wound correspondingly with the fine coil D, both co-operate in actuating the armature and in maintaining the magnetism of the permanent magnet P, and the main circuit remains closed as long as this condition exists.

Now, should the electromotive force of the dynamo di-

minish from any cause until it only equaled that of the accumulator, the current in the coarse coil C would cease or fall to zero, while the current in the fine coil would be insufficient to maintain the repulsion of the armature, which would promptly fall, and thus break the main circuit. On the other hand, should the battery-current become so strong as to reverse the current in the main circuit, the polarity of the coarse-coil C would at once become opposed to that of the fine coil D, and the preponderating influence of the permanent magnet P would at once attract the armature and break the main circuit. This property constitutes the main reason for the use of a permanent magnet, as it retains its polarity, instead of having it reversed by reversals of the current. Ordinarily the currents of the coils C D re-enforce the polarity of the permanent magnetism, and thus prevent its loss or change.

The advantage of employing the repulsive action of the magnets and currents, instead of the attractive, will be recognized when we consider the fact that sudden strong reversals of polarity frequently result in still retaining the circuit closed; in the arrangement above described, however, such a result is practically impossible, as both the currents and permanent magnet co-act to open the circuit.

These constitute the main features of the system adopted by the Electric Storage Battery Co., and the results obtained have been so satisfactory that a large extension of such storage battery plants is contemplated.

We may also note the fact that four cars on the Lehigh Avenue Street Railroad, in Philadelphia, have been operated continuously during the last four months with cells of the railroad type described above. This road has numerous curves, and grades as heavy as 5½ per cent. These have taxed the cells to their utmost, the 100 cells on each car frequently being discharged at the rate of 45 electrical horse power. During the month of August past, these cars alone carried 59,000 passengers, with frequent loads of 100 passengers on a car. The batteries have frequently made runs of 63 miles with a single charge under these conditions, thus giving a good indication of their increased efficiency where the conditions, are more favorable as to grades and curves.

A WIRING CHART.

BY JOHN WARING.

The accompanying chart for determining the size of wire was made over a year ago by the writer to illustrate a scheme for a chart which would have a large range and also be sufficiently accurate for ordinary use. In practice the chart should at least be extended to give loss in volts down to one volt. In designing the chart it was found necessary to assume the volts lost in the wire instead of the percentage of loss; otherwise a general chart could not be drawn.

The scheme for the whole design starts with Ohm's law that, $C R = E$; that is, the product of the current in any given wire by the resistance of that wire will give the potential difference necessary to force such current through the wire. Now if E be assumed constant we have the equation of a rectangular hyperbola referred to its asymptotes. The resistance of a wire varies directly with its length and inversely with its area of cross-section. It also depends on the kind of metal used. Hence the equation $R = \alpha \frac{L}{A}$; where L denotes length, A the area of cross-section, and α some constant depending on the kind of metal.

If we take the foot as the unit of length, and the circular mil as the unit of area, the constant for copper becomes about 10.3 in order to give ohms. By substituting the preceding value for R, the equation $C R = E$ now becomes $\frac{10.3\, C L}{A} = E$; or $\frac{10.3\, C L}{E} = A$. If E be now made equal to 10.3, then $C L = A$; which, interpreted, means that the product of amperes by feet will give the area of cross-section in circular mils, assuming the loss in volts to be 10.3.

It is evident that any arrangement of current and length whose product is constant, say 10,000, will give points on one hyperbolic curve, and that any other arrangement which will give another constant product, say, 20,000, will give points on another curve. Since in practice the product of current by length may give any value, there are an infinite number of hyperbolic curves to be drawn, each curve representing some fixed value for the area of cross-section. To prevent confusion only a few are drawn on the chart. The remaining values are interpolated by following along the imaginary curve to its intersection with the diagonal scale line. In the chart, distances on the scale of feet have greater value than on the ampere scale. The vertical scale has 200 feet to the division, the horizontal scale 50 amperes to the division.

Thus far the explanation has referred only to that part of the chart containing the curves. It has been shown that, if lines be drawn at right angles to the double-distance line and the initial line, their point of intersection lies on a curve whose value in circular mils is equal to the product of the intercepted values for feet and amperes, provided the loss in volts equals 10.3. Now, suppose that there is some other loss required than 10.3 volts, say, 4. Substituting this in a preceding equation, we have $\frac{10.3\, C L}{4} = A$; or $C L = A \frac{4}{10.3}$; that is, the product of current by distance only gives $\frac{4}{10.3}$ of the required area of cross-section. Hence, for 4 volts loss, the area required for 10.3 volts loss should be multiplied by $\frac{10.3}{4}$. This multiplication is done graphically on the lower part of the chart.

Following are the

GENERAL DIRECTIONS FOR USE.

The lines representing *amperes* are drawn below the initial line, and at various angles with the initial line. They would, if produced to the left and upward, all intersect at *.

The lines representing divisions of scale for *volts lost* are the horizontal lines below the initial line.

The lines representing divisions of scale for *complete length of circuit* in *feet*, are the horizontal lines above the initial line.

The lines representing the *area of cross-section* of wire in circular mils are the curved hyperbolas. The value of each is given at its intersection with the diagonal line.

Any one of the four quantities, *Complete length of circuit* in *feet*, *circular mils*, *amperes* and *volts lost*, may be found by selecting such a value for the desired quantity, that the intersection of *complete circuit* line and *circular mil* line is in a vertical line with the intersection of the *ampere* line and *volts lost* line.

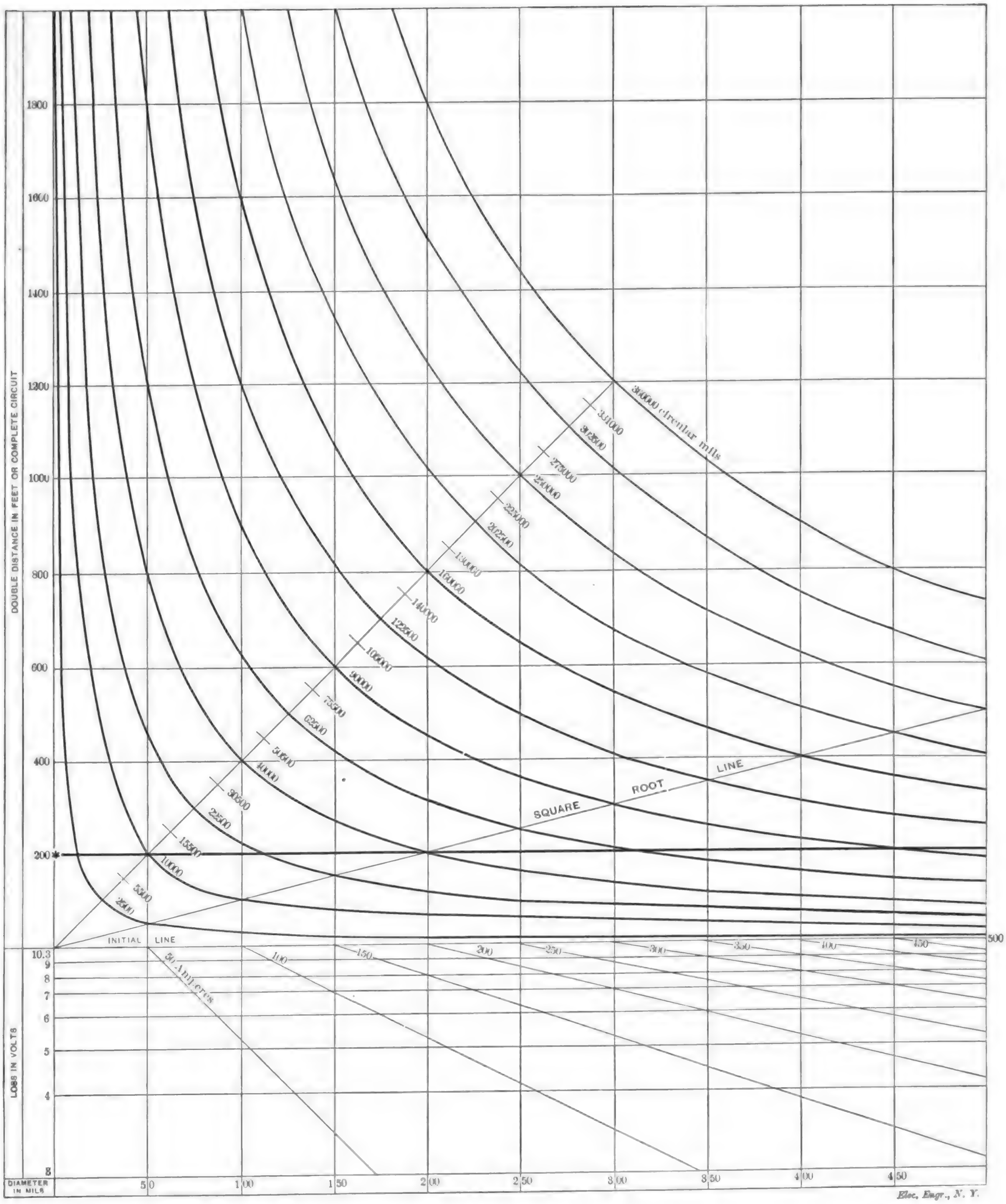
The scale may be changed by addding to or subtracting from *circular mil* values, the total number of ciphers added to or, subtracted from, values for *amperes* and *complete length of circuit*.

Below are given a few examples, illustrating the method of applying the chart :—

1. Required the size of wire to carry 125 amperes 800 feet complete circuit, with 4 volts loss. Note where the imaginary line for 125 amperes (this is a slanting line starting from 200 on the double distance line and passing half way between 100 and 150 on the initial line) intersects the line for 4 volts loss. Go vertically upward from this point to the 800 feet line. This latter point of intersection

gives a point on the required curve of area. Following this imaginary curve along to the scale, it gives a value of about 260,000 circular mils, or approximately the added areas of a No. 0000 wire and a No. 3 wire, B. & S. gauge. braic sum for the number of ciphers added and subtracted is 0, 122,500 is the correct result.

3. Required the size of wire to conduct 15,000 amperes 6,000 feet with 6 volts loss. Add two ciphers to the 150



Waring's Wiring Chart For Incandescent Lighting.

2. Required the size of wire to carry 5 amperes 12,000 feet with a loss of 5 volts. Drop a cipher from the 50 ampere line and add a cipher to the 1,200 feet line. Proceeding as in the previous example, the point comes about on the circular mils line marked 122,500. Since the alge- ampere line and one cipher to the 600 feet line. The required intersection is evidently a little more than 150,000 circular mils. Adding three ciphers to this, the result is 150,000,000 c. m. for the required wire—a pretty large wire. If the last example had called for 1.5 amperes to be carried 6

feet with 6 volts loss we should have dropped four ciphers and then obtained 15 c. m. as the required size. In a similar manner ciphers may be added to, or subtracted from, the volts lost; only in this case, when we divide volts lost by 10, we should multiply circular mils by 10. A current density scale might also be added to the diagram.

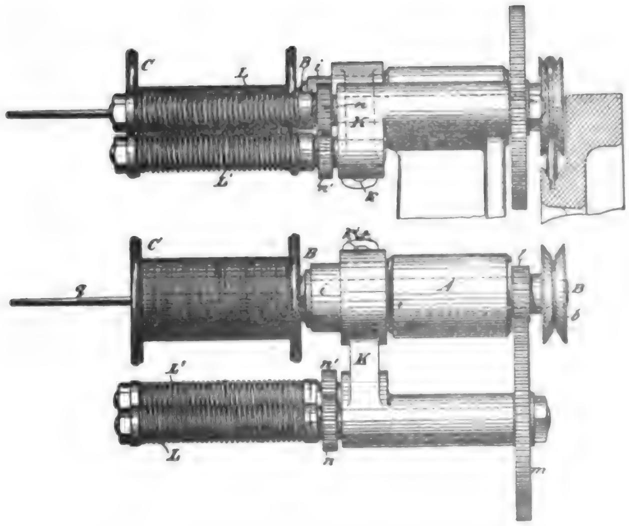
TABLE OF DIMENSIONS OF WIRE.

B. & S. gauge.	Diam. mils.	Cir. mils.	B. & S. gauge.	Diam. mils.	Cir. mils.
0000	460.00	211600.00	9	114.43	13094.00
000	409.64	167805.00	10	101.89	10381.00
00	364.80	133079.40	11	90.74	8234.00
0	324.95	105592.50	12	80.80	6529.90
1	289.30	83694.20	13	71.96	5178.40
2	257.63	66373.00	14	64.08	4106.80
3	229.42	52634.00	15	57.07	3256.70
4	204.31	41742.00	16	50.82	2582.90
5	181.94	33102.00	17	45.26	2084.20
6	162.02	26250.50	18	40.30	1624.30
7	144.28	20816.00	19	35.39	1252.40
8	128.49	16509.00	20	31.96	1021.50

WOOD'S MAGNET WINDER.

THOSE of our readers who have had experience in electrical manufacturing will appreciate any device that facilitates the winding of magnet bobbins and at the same time secures an even distribution of the wire. To obtain these advantages Mr. J. J. Wood, the well known inventor of the Wood arc machine and lamp of the Fort Wayne Electric Co., has contrived a very simple and ingenious arrangement which he has used for some time in his work and which has been recently patented.

The idea embodied in the device consists in guiding the magnet wire to and fro across the bobbin at a uniform



FIGS. 1 AND 2.—WOOD'S MAGNET WINDER.

rate and for changing the direction to right or left at either end when a layer is completed. The manner in which this is carried out by Mr. Wood, is shown in the accompanying illustrations. As will be seen, a bearing frame K carrying two guide spindles L L′ is clamped to the sleeve *i* within which the spindle B turns. On the right hand end of the spindle L is fixed a gear wheel *m* which is driven by the pinion *l*, fixed to the spindle B. On this spindle L is fixed a pinion *n*, which meshes with a pinion *n′* on the spindle L′, so that the latter is driven from the former, the two rotating in opposite directions and at the same speed. The guide-spindles L and L′ have spiral grooves to engage and guide the wire as it is wound upon the spool. The grooves are practically screw threads with the bottom and top of the threads rounded off in order to avoid sharp corners.

In he operation of winding, the operator guides the wire with ne hand, the wire passing through between the spindles L L′. By drawing the wire upwards so that it enters a groove in the guide-spindle L, it is caused to travel laterally from one end of the magnet-spool to the other at a speed determined by the pitch of the spiral groove and the speed of the spindle L proportionally to that of the spindle B, so as to wind on the successive convolutions of the wire close together and make a continuous layer of wire. When the wire reaches the end of the spool, the operator has only to move his hand downwards to bring the wire into the groove of the guide-spindle L′, by which the wire is propelled in the opposite direction, and travels back to the opposite end of the spool.

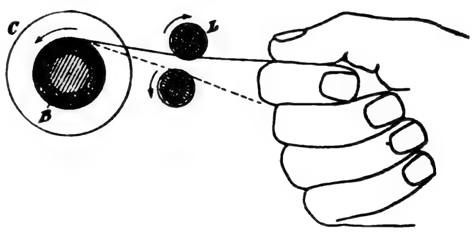


FIG. 3.—WOOD'S MAGNET WINDER.

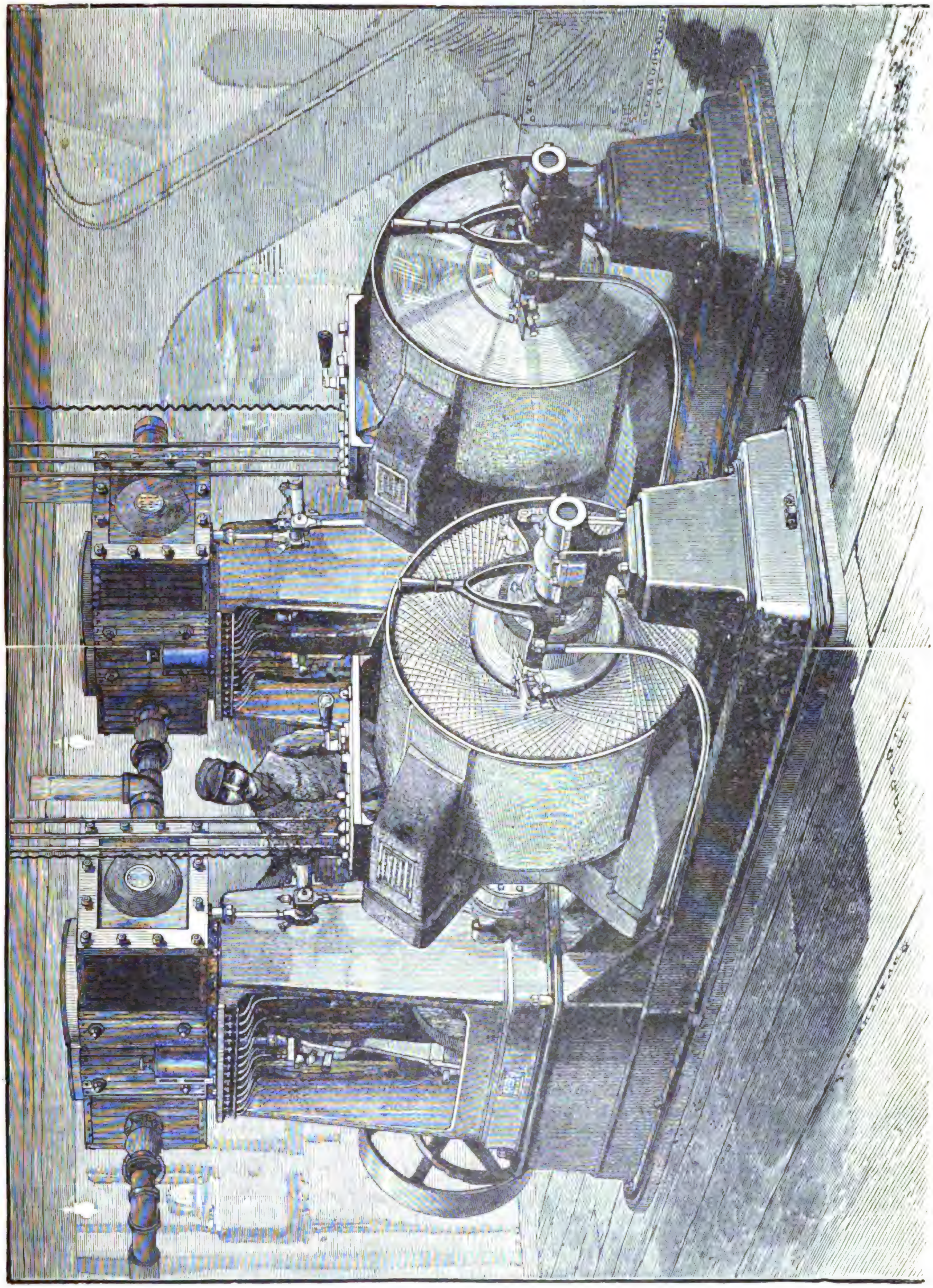
The operator has thus only to move his hand up when the wire reaches one end of the spool and down when the wire reaches the other end, keeping the wire at a proper tension by holding it between the thumb and finger, as is usual in winding magnets. In Fig. 3 the upper position of the wire is shown by a full line, and its lower position by a dotted line.

The sizes and proportions of the guide-spindles, L L′, the pitch of their grooves, and the proportionate speed of their rotation, must, of course, be varied according to the varying sizes of wire to be used and the sizes and proportions of magnets to be wound.

THE ELECTRIC LIGHTING PLANT ON BOARD THE "PLYMOUTH."

SOME of the most interesting electric light work of recent date is that done upon shipboard, for the reason that the exigencies of the case demand the utmost efficiency of apparatus within a limited space. The output per pound of material must be high, every inch of room that can be spared is an object to the ship builder and designer, the construction must be simple and strong, and the whole is subjected to conditions of a trying and exhaustive nature.

The new navy that this country is now putting afloat has offered some excellent opportunities to the electrical engineer, but others are found in the mercantile marine. A few weeks ago we took occasion to give details of the new plant on board of the "Seguranza," and now, thanks to the courtesy of our enterprising contemporary, the *Scientific American*, which has just published an article on the ship and her entire equipment, we are enabled to give a view, with data, of the plant on board the new Old Colony steamboat "Plymouth." This plant was put in by the Edison General Electric Co. under the special superintendence of Mr. W. H. Peirce, of the Old Colony Company. Two dynamos, driven each by an independent compound Ball engine of 65 horse-power at 120 pounds pressure, are used as generators. They are connected directly to the engine shaft, and run at 400 revolutions per minute. The field has eight poles, four external, all of one sign, and four internal of the opposite sign. Within the zone marked by the eight pole-pieces the armature which is a Gramme ring, rotates. The core of the ring is



Dynamo Room of The Old Colony Steamer "Plymouth."

of laminated sheet metal. Each dynamo has an output of 350 amperes at 115 volts potential, enough to supply 700 lamps. Each dynamo weighs 6,563 pounds, each armature, 1,950 pounds, and the dynamo and engine and appurtenances weigh about 13,000 pounds. The commercial efficiency is 81 per cent., and the heating is only 36° F. above the atmosphere. The machines are compound wound, and show a maximum variation in their characteristic curve of 1 volt. They are of a type conforming to specifications originally issued by the United States government.

The installation is on the two-wire system. The dynamos are connected in parallel so that one or both can be used to feed the circuits. From the generating plant double leads are taken fore and aft, and branching so as to terminate at four cut-outs. From these cut-outs the lamps are supplied directly or by feeders. The main leads are not tapped. As more work might be thrown upon one main lead than on the other, equalizing mains are carried from each forward cut-out to each of the after cut-outs. This gives four distributing points. Risers are carried through the decks to supply the lights at different elevations.

Below the main deck wherever moisture may be present, lead-covered wires and water-tight brass junction boxes containing safety fuses are used. Elsewhere Habirshaw marine core wire is employed.

The staterooms are grouped in eight divisions. For each of these a marbleized slate tablet placed so as to fill an alcove transom is provided, on which the switch boxes and general branch connections are made. This is done not only for the decorative effect, but also to provide security from deterioration by moisture and from fire.

There are 1,250 16 c. p. 110 volt lamps. The maximum variation in potential will not exceed 1½ volts. Each lamp has its own key switch, so as to be individually controllable. In the dining saloon the lamps are arranged in groups of ten, and connected with a main switchboard by which they can be turned off ten at a time as desired. The very elaborate saloon electroliers and other fixtures were supplied by the New York works of the Edison General Electric Co.

LIEBIG AND WILLMS'S PORTABLE CHLORIDE OF SILVER BATTERY.

The accompanying illustrations exhibit a new construction of galvanic cells, devised by Dr. G. A. Liebig and Mr. Charles Willms. The battery is designed for low internal resistance and to be safely and conveniently portable. Particular care has been given to provide a protection against injury to clothing or other objects from the escape of liquids upon the breaking of one or more cells, and to provide a vent for the injection of the fluid, and for allowing, when it is deemed advisable, any gases to pass off. The cells may be put up and used singly or in groups.

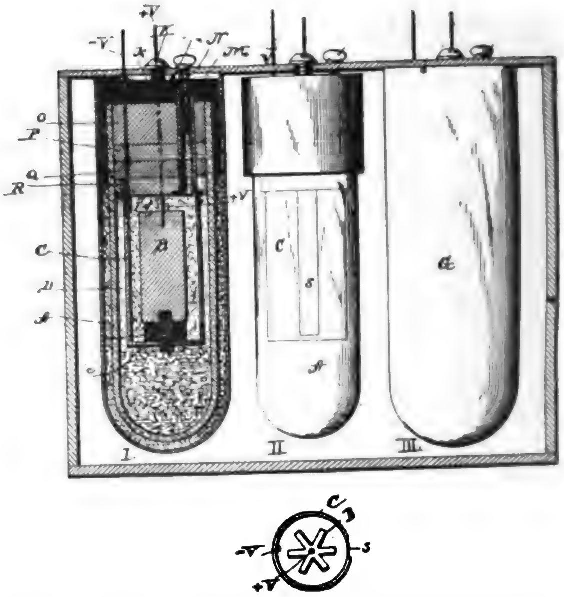
Fig. 1 represents a section through a battery of three cells, cell I in section, cell II with the metal case removed, and cell III with the metal case on. Fig. 2 represents a cross-section of the two electrodes at right angles to their axes.

The cell consists of a case A, of glass or other suitable material, sealed, containing the electrodes B and C and the exciting-fluid D. Over the glass case is cemented a hard-rubber cap. The cell is then wrapped with cotton cloth or other soft absorbent material, and pushed firmly into a metal envelope G, where it is held in place by a metallic pin, or by indenting the metal envelope, above the rubber cap. The object of the hard-rubber cap is to furnish a solid hold for the screw K, by which the cell is firmly held against the cover of the battery when used in groups.

The vent M and plug N are for injecting the fluid, and to allow the gases generated to escape when desired. The wrapping of cotton or other absorbent protects the glass from breaking in the metal envelope when carelessly handled, or in the event of such breakage it absorbs the liquid. The metal envelope protects the cell and contents and serves to retain the liquid if the glass cells be broken by accident.

The cell is hermetically sealed by no less than four layers of different compounds, one above the other, as shown in Fig. 1. The hard sealing R is a mixture of resin and gutta percha; Q is a viscous sealing of resin and resin-oil; P is the same mixture as R, and Q is a compound of plaster-of-paris and pine resin, or shellac.

The internal resistance is made small by increasing the surfaces of the electrodes and by bringing them into close proximity. The zinc electrode C is a cylindrical roll with one end turned over, forming a cylinder-head *c*. A longitudinal slot *s* is cut in the cylinder to allow free access of the fluid.



FIGS. 1 AND 2.—THE LIEBIG-WILLMS PORTABLE CELL.

The positive electrode is formed of a corrugated or star-shaped mass of chloride of silver fused about a piece of silver wire + V. This fits closely within, but nowhere touches the zinc electrode. The silver electrode is supported on and steadied by an insulating-disc which rests on the bottom of the zinc cylinder. The spaces between and around the electrodes are filled with filter-paper, cotton, or other absorbent material, and then the vent is closed, and after the fluid is injected the cell is ready for use. This absorbent material is well saturated with the zinc-sulphate solution, the absorbent being used to prevent the cell being emptied should it be overturned or laid on its side when the vent-plug is either loose or out. + V is the wire leading from the positive or silver pole, and — V that leading from the zinc-pole.

When a number of cells are used in a portable battery, they are screwed to the lid of the box containing them, and melted pitch or paraffine is poured into the box and allowed to solidify; but the melted pitch or paraffine is not necessary, as the screws are sufficient to hold the cells firmly in place against any ordinary jars or strains.

THE DEATH OF LINEMAN KOPP.

The Coroner's Jury has rendered a verdict that Kopp would not have lost his life had he exercised proper care, and further that "while said August Kopp did not exercise proper care, it has appeared in evidence that the defective insulation, which existed at various arc lamps was a necessary factor in causing his death; and that the existence of such defective insulation was countenanced by the Board of Electrical Control. It is the opinion of this jury that the operation of high tension electric circuits in such condition is a dangerous practice."

THE ROBERTSON FIBROUS CARBON BATTERY.

A LARGE number of modifications of the original Leclanché cell have appeared in the past, one of the principal objects being of course to obtain as large a surface as possible of the carbon in order to reduce the resistance and to prevent polarization. But the prevention of polarization depends to a large extent also upon the nature of the surface of the carbon, it being well known that a smooth surface retains the gases liberated, while a roughened surface allows the bubbles of gas to be readily detached. In order to retain both these advantages in a simple and cheap

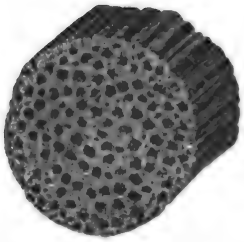


FIG. 1.—SECTION OF FIBROUS CARBON MAGNIFIED.

construction, Mr. J. Hart Robertson, of this city, has recently brought out a novel type of the sal-ammoniac cell, which is worthy of note. Mr. Robertson employs for his negative terminal a carbon made of vegetable fibre prepared and carbonized in a special way. This form of carbon is shown in magnified section in the accompanying engraving, Fig. 1. The corrugation of the fibre from which the carbon is made, delays the polarization, and is claimed to give the same result as is obtained by the use of the bioxide of manganese prisms in the Leclanché cells, but in

FIG. 2.—THE ROBERTSON FIBROUS BATTERY.

a more natural way, the carbon itself, unlike the ordinary granular form, doing what is done artificially in the Leclanché cell. The large surface exposed to the action of the liquid is evident. At the same time, in addition to the large surface, the resistance of the carbon itself is very small.

Two types of cells have been made by Mr. Robertson. In the first of these, shown in Fig. 2, the carbon fibre is arranged in horizontal spiral form, while in the other the carbon rods are arranged vertically surrounding the zinc cylinder fixed in the centre.

The battery is claimed to have very low external resistance and to be specially adapted for telephone purposes as well as for burglar alarm, annunciator and similar open circuit work. A departure is also being made in the application of battery jars made of the well known insulating material "fibrone," which is not only handsome

FIG. 3.—THE ROBERTSON FIBROUS BATTERY.

in appearance, but is safe from breakage, and in connection with a tight fitting cover effectually prevents leakage and the creeping of salts.

FIGURES OF THE FRENCH TELEGRAPH SYSTEM.

Referring to the recent international telegraph conference at Paris, *Le Figaro* gives an account of the development of the French telegraph system since the last international conference held at Berlin, Germany, in 1885.

In that year the total number of telegrams sent in the French Republic figured up 44,000,000. In 1889 it amounted to 55,000,000, showing an increase of about 25 per cent. in the four years. The percentage of increase in the number of telegrams sent to, and from, points outside of France is still greater, closely approximating to 40 per cent. For press dispatches a reduction in price of 50 per cent. has been effected. In the matter of cable service it is of interest to note that the control of the cable between France and England has passed into the hands of the government. The "Compagnie des Télégraphes de Paris à New York," further, has severed its connections with other companies, so that it now has its own independent cable to the United States. A new company, known as the "Société des Télégraphes Sousmarins," has been formed, and has commenced and partly completed cable lines to Venezuela, Curacao, San Domingo, Hayti and Cuba, as well as to the French colonies, Martinique and Guadeloupe.

In the matter of telephone communication the period from 1885 to 1890 marks the opening of the line between Paris and Brussels, and the completion of the 560-mile line between Paris and Marseilles.

BROOKLYN, N. Y.—President Lewis, of the Brooklyn City Railroad, and his Directors find it hard work to decide upon some system of electrical propulsion for his surface cars. He has just concluded a visit of inspection to Lansingburg, Waterford, and Cohoes, and is going to Boston, Buffalo, Cleveland, Utica, Syracuse and Rochester next week. So far he favors the overhead trolley system.

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New England Editor and Manager, A. C. SHAW, Room 70—680 Atlantic Avenue, Boston, Mass.
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Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

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VOL. X. NEW YORK, OCTOBER 8, 1890. No. 127

The history of science teems with examples of discoveries which attracted but little notice at the time, but which afterwards have taken root downwards and borne much fruit upwards.—Lord Rayleigh.

ALUMINIUM IN THE ELECTRIC ARTS.

KEEN observers of the course of events and of the changes which have gone on in electrical construction cannot fail to be impressed with the difference in the relative positions occupied by the metals which are employed in the electric arts, as compared with their status ten, or even five, years ago. We refer not merely to the quality, as exhibited by the higher standard of purity now generally obtainable in copper, but also to what may be considered the economic aspect which the electrical engineer must take into consideration in his calculations. Thus what but a few years ago was considered sufficiently good material for most electric contacts is now in many cases discarded, and brass has given place to German silver and to platinum successively. With the increase in the use of the latter metal has come an increased scarcity of supply, so that the two causes have combined to raise the price of this material to nearly three times its value of but a few years ago. How important a factor this is may be recognized when we take into consideration the fact that the platinum leading-in wires of an incandescent lamp formerly costing but three cents now involve an expense of about eight cents per lamp, having become indeed the largest single item involved in the cost of manufacture. For this particular purpose there has been thus far no substitute even suggested, as the conditions to be fulfilled are very exacting and involve the very life of the lamp.

But in other directions we note a tendency to the substitution of a metal which by present indications is destined to play an important part in electro-technics. We refer to aluminium, the extraction of which is steadily advancing so that even to-day it is brought within the reach of economic application though selling at the rate of two dollars per pound. While formerly but sparsely employed in the construction of parts of delicate electric measuring instruments it has already found an application among others in the construction of electric contacts where its non-corroding properties make it eminently available, though its comparatively low fusing point hardly renders its use advisable in situations where actual sparking is likely to take place.

The present cost of aluminium would appear to prohibit its use for many purposes in which its qualities of lightness, strength, etc., would otherwise make it available, but upon closer investigation it may be found that even at its present price it may be advantageously employed. Thus there are many situations where nearly every other metal employed is found to give trouble and, indeed, would require renewal after but comparatively short life. Among these are the numerous electric fittings employed in mines subject to continual dampness and flow of water, and which are found to give out very rapidly. As their weight is comparatively small, it may not be found against the interests of economy to employ aluminium.

But looking further still, anticipating, as there seems every reason to hope for, a considerable reduction in the price of aluminium, we may count on an extended use of this metal in the electric arts. As one of these we need only refer to its use in connection with electric railway work. Its great lightness and strength make it eminently adapted for overhead line work, its specific gravity being but 2.6 as compared with copper which has a specific gravity of 8.9; in other words, being in the ratio of 3.5 to 1 in favor of aluminium. Its conductivity, it is true, is nearly twice that of copper, but on account of its low specific gravity, its weight would only be about four-sevenths that now required in copper for the same conductivity. Looking still further, there are many of the parts which go to make up an electric car that could be made of aluminium to-day and which would tend materially to reduce the car weight without affecting its strength or efficiency. Thus among other details, the trolley wheel and trolley pole might be made of aluminium to considerable advantage, and we believe we are not far from seeing such a practical application. If to this were added the substitution of aluminium for iron and brass now employed on the truck and motors, outside of the magnetic circuit, the reduction in weight would be an important factor tending to economy.

What has just been said with regard to overhead electric railways is still more applicable to storage battery cars. If it should, for example, be found practicable to construct storage batteries with plates of aluminium, the most serious question now confronting the workers in this field would be at once removed. Besides, with lighter mechanism to haul, there would be less drain of current.

It is true that we may be looking ahead slightly, but it is nevertheless well to call attention to facts which are clearly within the bounds of possibility and, indeed, of probability. The high cost of the metal even at the present time does not place it beyond all reach of application in its pure state, and if to this be added the fact that, like platinum, it would maintain nearly its full value even as old

material, the money invested in it could not by any means be looked upon as sunken capital. Aluminium is soon to be one of the best friends of the electrical engineer, and to-day it invites him to more intimate acquaintance.

ELECTRIC WELDING.

Among the papers read before the British Iron and Steel Institute, was one by Prof. Elihu Thomson, on electric welding. The process is now so well known that it is hardly necessary to call special attention to it as a novelty, but in the paper read by Prof. Thomson, the subject is discussed from the metallurgist's standpoint, and a variety of interesting facts not heretofore brought out are referred to. The peculiar actions of the various metals under the influence of the welder present a good field for experiment. The large number of machines already constructed for various purposes shows the extent of the field in this direction. Our readers will also note that Prof. Thomson considers welding by the arc to be impracticable, holding that all processes can be carried out completely and successfully by the "incandescent" method.

ELECTRICITY IN MINING AND METAL WORKING.

The large scope presented for the application of electricity and magnetism in mining and metallurgical operations is gradually obtaining proper recognition, and no better indication of this can be found than in the attention given to electricity at the meetings of the British Iron and Steel Institute and the American Institute of Mining Engineers held in this city last week. The papers there read covered a wide range of electrical subjects, and showed how, from the very first step in gaining the raw product in the mine, every stage in the operations leading to the last preparations for the market can be facilitated economically by electricity. Thus, Mr. H. C. Spaulding's paper gives an excellent résumé of what has been accomplished in electric mining work, including drilling, underground hauling, hoisting, lighting, etc. It is interesting to note, also, that the demands of mining work seem destined to call to renewed life a type of machine that has been abandoned for a long time as an electric motor, but which possesses certain advantages, and that is, the electric reciprocating engine. For drilling operations it is likely that thus we shall soon see a revival of this type, and the description by Mr. Van Depoele of his reciprocating drill shows in what manner the new apparatus differs from the original types of this class, among which the Page motor is perhaps the most generally known.

The progress made during the last few years in magnetic ore separation was also emphasized by the records presented in several papers, and we may look for a wide extension of this method of ore separation in the future. It is noticeable that in these machines the tendency at present is in the application of alternate polarity in the magnets, and with good reason, as explained in the description of the Monarch separator. With such a variety of electrical work confronting the mining engineer, his course of study must hereafter largely embrace electricity, a knowledge of which will, of necessity, be as valuable to him as expertness in assaying is at present.

Electric Cars.

The paper read lately by Mr. McNamara before the State Railway Convention is worthy of the attention of the manufacturers of street railway apparatus, in the first place, because it was an unqualified endorsement of electricity for street railway purposes, and, in the second place, as it pointed out certain directions in which improvements are desirable. Thus, he remarked that on account of the construction at present adopted the ease of access to and from the car is somewhat impaired on account of the raising of the car body above the height formerly in vogue. This has naturally been brought about by the increased height of the truck due to the placing of the motor upon it. The remedy must be looked for, therefore, in a more compact arrangement, or a possible recourse to an older form in which the motor is carried on the platform of the car in a compartment separated from the rest. Mr. McNamara also referred to the position of the motor as being subject to the accumulation of dirt and dust. This, no doubt, is true, but we think the time will come when every motor will be so thoroughly protected, even in its present position, that this objection cannot hold.

A New Tax System for Maine.

The special tax commissioners of the State of Maine have made a report to Governor Burleigh recommending radical and important changes in the system of taxation. One feature that we note is the taxing of telephone instruments leased or royalty paying. This is apt to go hard on companies that are already giving up a good share of their receipts, for the telephone rates in Maine are not very high. Another item that impresses us more favorably is the proposal to tax all new corporations for their charters and on their capital stock at par. Maine has been resorted to by a large number of speculative and rotten concerns. For the six months ended July 1, corporations with an aggregate of over $85,000,000 capital stock were formed there. Liberal corporation laws are a boon, but lax laws are an evil, and most of all to the companies formed with honest purpose for solid business. Maine can afford to make this reform.

New Storage Battery Work.

While not attracting as large an amount of attention as some of the other departments of electrical engineering, it is undeniable that the storage battery in its various applications is steadily forging ahead and securing a firm foothold both in lighting and traction work. As showing the latest progress in this direction in this country, we illustrate elsewhere the new system of the Electric Storage Battery Co., in which the method of preparing the storage battery plates varies considerably from that heretofore generally employed. The application of the chloride, after a long series of experiments, is also a new departure claiming attention, as up to the present the various lead oxides have been almost exclusively employed for the purpose. Mr. Currie has also combined with his system several novel regulating devices, among which the reversal preventer, acting by magnetic repulsion, and the ingenious little "full charge indicator" may be noted as exceedingly simple and effective.

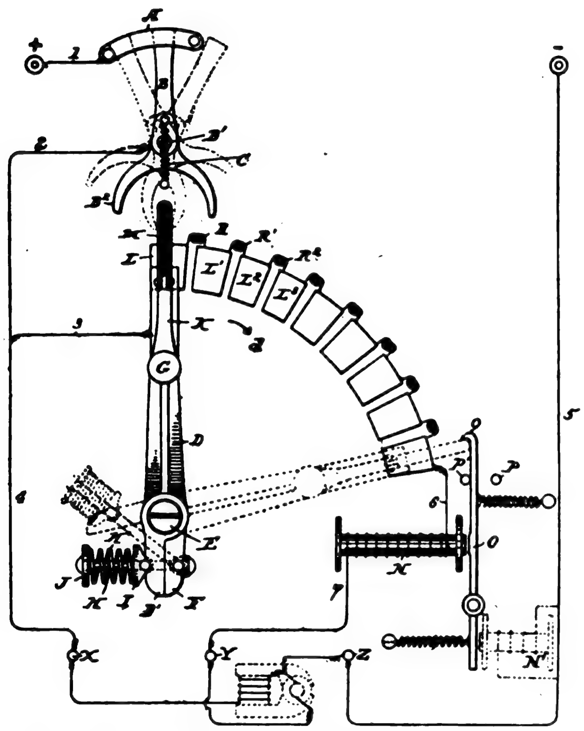
RAE'S AUTOMATIC SWITCH FOR STATIONARY MOTORS.

MR. FRANK B. RAE, of Detroit, who has of late been devoting his attention to power applications, after his extensive experiences in other fields of electrical work, has just brought out an ingenious automatic switch for the protection of motors against the consequences of a sudden rush of full current after a motor has been stopped by an interruption of current or greatly retarded by a diminution of current.

The switch is intended to be used in connection with the usual shunt-wound motors and provides an automatic device that breaks the connection between the main line and the motor in event of interruption or variation in the circuit.

The accompanying engraving represents diagrammatically the arrangement of the device.

In the use of electric motors on a power circuit it often happens that through accident or otherwise the circuit is interrupted or the current materially reduced, and more especially is this liable to occur when stationary motors are



RAE'S AUTOMATIC SWITCH FOR STATIONARY MOTORS.

operated on circuits supplying electric-railway motors, in which there may be sudden changes in the current, or the feeding-line may be broken, or the limit-switch may open at the station, or other contingency may arise which would cause the power-motor to stop or become considerably retarded; and if this happens when the motor is used with the ordinary switch, the subsequent closing of the main circuit is liable to cause injury or destruction to the motor, from the fact that the armature part of the motor is so connected that, practically, the whole current passes through the armature without meeting a proper resistance in the shape of counter electromotive force, and a burnout or injury to the armature ensues. Mr. Rae's switch first closes the circuit upon the shunt-field direct and through a resistance in the armature-circuit, which resistance is gradually and successively cut out by a continual movement of the switch-lever, and when the lever is fully closed the circuit is direct through both the field-coils and armature of the motor, and the switch is locked or held in place automatically as long as the current is flowing within its normal limits. An electro-magnet is connected in the armature-circuit, for holding the switch in position, and if from any cause the circuit is interrupted or materially lessened the magnet loses its attractive force and releases the switch-lever, which is operated by a spring or otherwise, to return to its normal position, the lever being so arranged that it will automatically operate a circuit-breaking switch to disconnect the motor from the feeding circuit.

Connected to the + terminal is a contact-piece, A, and arranged to co-operate with it is a break-switch, B. This break-switch is pivoted at B′, and it has a spring, C, attached to the lever between its pivot and contact-point at one end, the other end being fixed below the pivot-point; thus, if the lever, B, is carried past a perpendicular line in either direction the spring will tend to carry the lever to the extreme of its position on one side or the other, as indicated in the dotted lines, effecting a quick or snap make or break between the lever and the contact, A. The lower end of the lever, B, has two horn-like extensions, B², whereby it may be automatically moved in the manner to be described presently. Below the circuit-break is a lever, D, pivoted at E, and having a handle, G, for manipulation. Means are provided for normally maintaining the lever, D, in a vertical position and for returning it thereto automatically when released, through a projection, F, up the stationary support of the lever, to which projection a bolt, H, is secured, passing through, D′, and provided with a compression-spring, H′, held in place between the pivoted washer, I, and flat washer, J, and operating to restore the lever, D, to its normal vertical position. Upon the lever, D, is a contact-piece, K, pressing upon contact-blocks, L L′ L² L³, etc., connected in series by resistance-coils, R R′ R², etc. Extending upward from the lever, D, is a finger, M, of insulating material, arranged to impinge upon the horn-like projections of the circuit-breaking switch, and to operate it to break the circuit, as described below.

Arranged adjacent to the switch-arm and resistance-contacts is an electro-magnet, N, the coils of which are connected in the armature-circuit. The armature, O, for this magnet is under the stress of a spring, Q, which normally holds it against the stop, *p*. When, however, the magnet is energized, the armature is attracted, and its free upper end has a hooked projection, *o*, which is arranged to engage with the end, M, of the switch-lever, D, and to hold the lever in the position shown in dotted lines against the stress of the spring, H′, when the normal current is flowing.

The arrangement and purpose of the electrical connections of the switch are obvious and need no further explanation. When the switch-arm D, is moved to the position shown in dotted lines the resistance-coils are cut out of the armature-circuit and the current flows through the shunt-field and armature in the usual manner.

While, as shown, the magnet is arranged in the armature shunt-circuit, it is evident that it might be arranged, and in some conditions it is preferable to so arrange it, in the circuit, 5, as indicated in dotted lines, N′, when of course its operation would be the same, except that it would be controlled by the full current flowing through the switch, instead of the armature-shunt current only.

The operation of the switch is as follows: In the neutral position the lever, D, is perpendicular, the right-hand horn projection of the switch, B, resting against the insulating-piece, M. A movement of the switch to the right carries the arm, B, past the centre of its pivot toward the left and the spring, C, continues the movement, closing the circuit at the contact, A. This energizes the shunt-field coil of the motor, the circuit being completed, the armature-current passing through the branch conductor and the resistance-blocks, thence around the coils of the magnet to the binding-post, Y, of the motor. The continued movement of the lever cuts out the resistances until it reaches the position shown in dotted lines, when all of the resistances are out of the armature-circuit and the lever, D, is locked by the hook of the armature, O, and the magnet, N,

whether in the armature-circuit or the main-circuit, holds it in position under normal currents. If, however, from any cause the main circuit is interrupted or falls below a given strength, the armature will be retracted by its spring, Q, releasing the switch-arm, D, which will fly back to its upright position under the influence of the spring, H′, and when the lever nearly reaches its limit the projection, M, will strike the left-hand horn, B², of the switch-lever, B, and carry this lever past the central line toward the right, when the spring, C, will continue its movement, breaking the main circuit at A. If it is desired to stop the motor at any time when a normal current is flowing, the armature, O, may be pulled away manually, and the same operations will automatically cut-out the circuit and leave the switch in condition to receive the circuit properly when again applied to the motor.

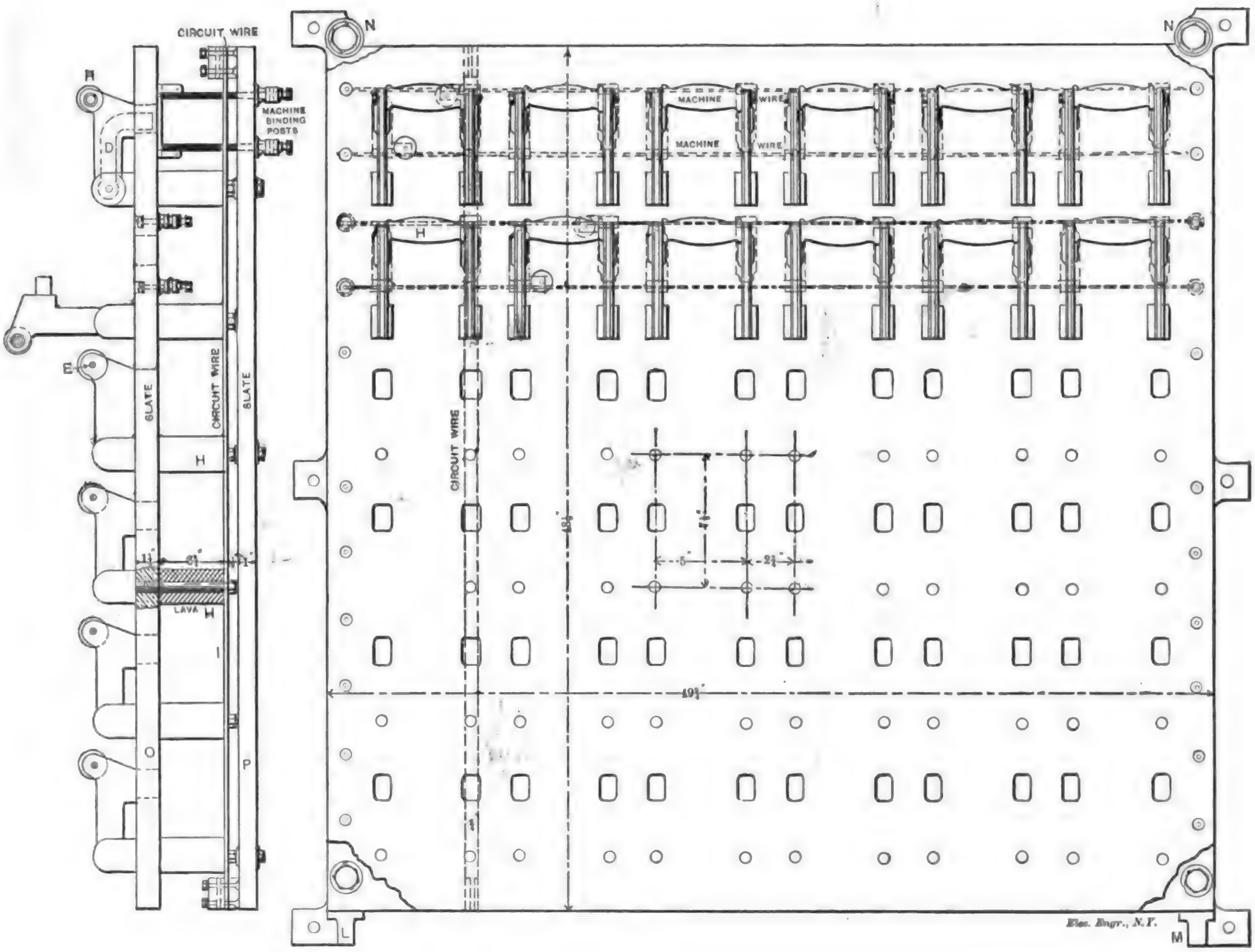
THE "FOSTER" STATION SWITCH-BOARD.

The experience of the past has shown that the prime requisite of a station switch-board is thorough insulation and fire-proof qualities. To this, in no less a degree, must be added a compact arrangement by which circuits and machines can be readily interchanged and in which the wiring can be readily inspected at all times. In carrying out this idea the Thomson-Houston Electric Company have recently brought out an exceedingly simple and effective arrangement, the design of Mr. Henry A. Foster, of this city.

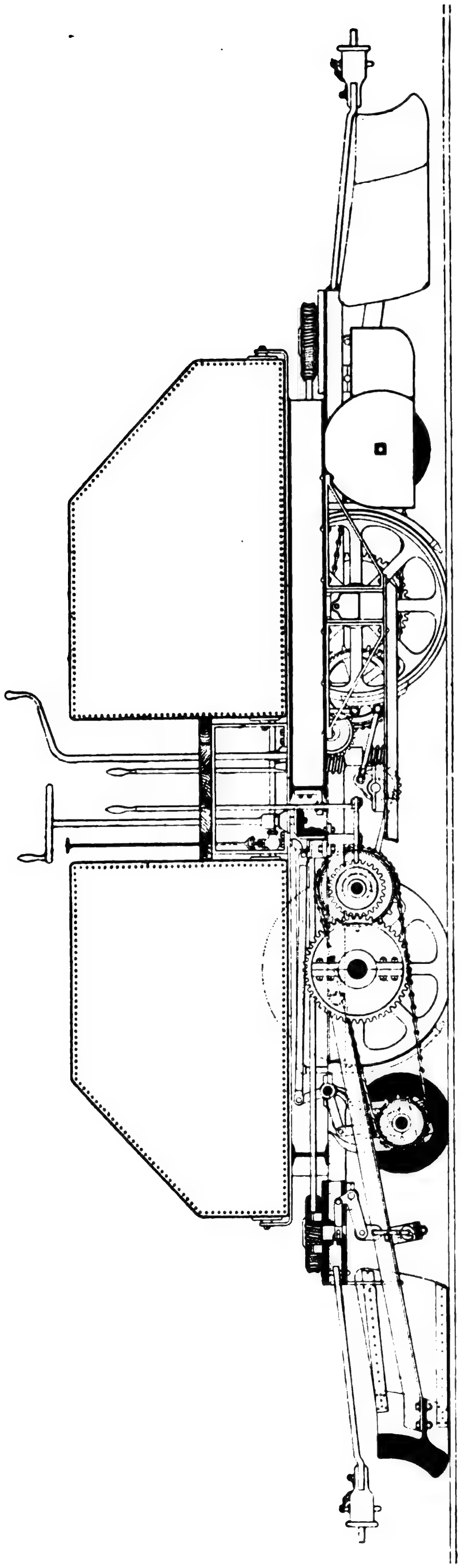
The board, which is shown in front elevation and in section in the accompanying illustrations, has been so designed that upon its exit from the factory it is, so to speak, completely wired up, so that all that is necessary is the leading of the wires from the machines and circuits to a set of binding posts attached to the board, thus making it unnecessary for the station operators to apply a single inch of wire to the back of the board. In order to obtain thorough fire-proof qualities, the base upon which the switches are mounted is made of slate, and the rear board is also of the same material. These two boards are separated by lava sleeves which encircle the bolts connecting the two boards.

It will be noted that the wires coming from the machines are connected to the horizontal circuits behind the board marked "Machine Wire"; while the circuits going out of the station are connected to the vertical bars marked "Circuit Wire." By means of the switches shown it is therefore evident that any machine can be connected to any circuit, at will, by simply throwing in the proper switch.

The switches themselves consist of brass tongues D which are entirely surrounded by the insulating material "fibrone" except at the points where the tongue enters the clips for connection. The switches, it will be noted, make a double break, the two tongues being connected by an insulating handle, also made of fibrone. It will be seen that the board occupies a wall space of only four feet square. Four of these boards have recently been placed in the station of the Manhattan Electric Light Company, in this city, and the ease of manipulation, as well as their absolute fire-proof qualities, have given great satisfaction. The board shown has a capacity for six circuits and six machines, and is open to inspection at all points.



THE FOSTER SWITCH-BOARD, MANHATTAN STATION, NEW YORK CITY.



THE "AJAX" ELECTRIC SNOW PLOW AND CLEANER.

THE AJAX SNOW PLOW AND TRACK CLEANER.

The accompanying cut represents a snow plow built for the St. Louis and East St. Louis Electric Railway Co. by Morris Wuerpel, Mechanical Engineer of the St. Louis Bridge and Tunnel Railroad. The machine is designed to perform three separate operations. The first removes the snow from the track by means of the plows seen at each end, either one of which can be raised or lowered according to the direction in which the machine is being run. The second sweeps the rails perfectly clean, which is done by the revolving metal brushes placed at each end just behind the plows and having motion transmitted to them from the main axles by chain and sprocket wheel arrangements from the motor, the revolving brushes being raised and lowered in the same manner as the plows, but independently of them. The third operation consists in sprinkling a solution of cloride of calcium on the rails, to melt the ice. The use of salt on street car tracks being now prohibited in many cities, the inventor sought to find some substitute which would be unobjectionable. A solution of cloride of calcium was found to be the thing desired; being a liquid it can be more effectually placed on the rails, and its efficiency as an ice destroyer is not equaled by any other material. It adheres to the rail readily, having a gummy consistency. The solution can be made at a cost not exceeding three cents per gallon. The solution is contained in the two tanks which are connected together at the bottom, the liquid being deposited on the rails by pipes with nozzles which extend down to the rails in front of each wheel. The machine is used by being placed ahead of the motor car.

STEAM ENGINEERING AT THE PHILADELPHIA EDISON STATION.

One after another the great cities of the country are evincing their appreciation of the electric light in an unmistakable manner. In spite of rapid increase of plant and facilities, the supply of current has not yet in a single one of them caught up to the demand and consumption. The last few years have seen not only the remodeling and enlargement of old stations but the building and equipment of new ones with whose vast proportions and massive machinery we are hardly yet familiar; and these in turn are likely to be running to their utmost capacity in a very short time.

An instance of this nature is afforded by the Edison station in Philadelphia, of which we here show a fine illustration of the exterior, Fig. 1, with a sectional view of the interior, Fig. 2. This station, which was built on plans of Prof. W. D. Marks, of the University of Pennsylvania, the engineer-in-chief of the company, will, when fully equipped contain a plant of 10,000 h. p. Large as the building is, however, it measures only 98 by 69 feet inside the walls, giving but one square foot to 1.4 h. p. The engines are those of the Armington & Sims Engine Co. There will in time be 20 of them, each of 500 h. p. and each driving 2 Edison dynamos. The engines are, as shown, on the first floor. The dynamos are on the second. The third floor is occupied by boiler flues, enclosed ash track, ash pit shutes from the floor above, blowers, blast pipes, a machine and repair shops, and store rooms. The fourth floor is devoted to boilers with a capacity of 5,000 h. p. The fifth and sixth floors are to be a repetition of the third and fourth. The seventh story is for coal storage, while the executive offices occupy the top. The coal is carried up in elevators and then dropped from the store bins to the boiler fronts by suitable shutes.

Owing to the rapid growth of business, the station equipment is to be increased this fall. The company has at present twelve No. 60 dynamos of 1,075 amperes each, and six more are to follow between now and December. Six fine Armington & Sims engines, of a nominal capacity of

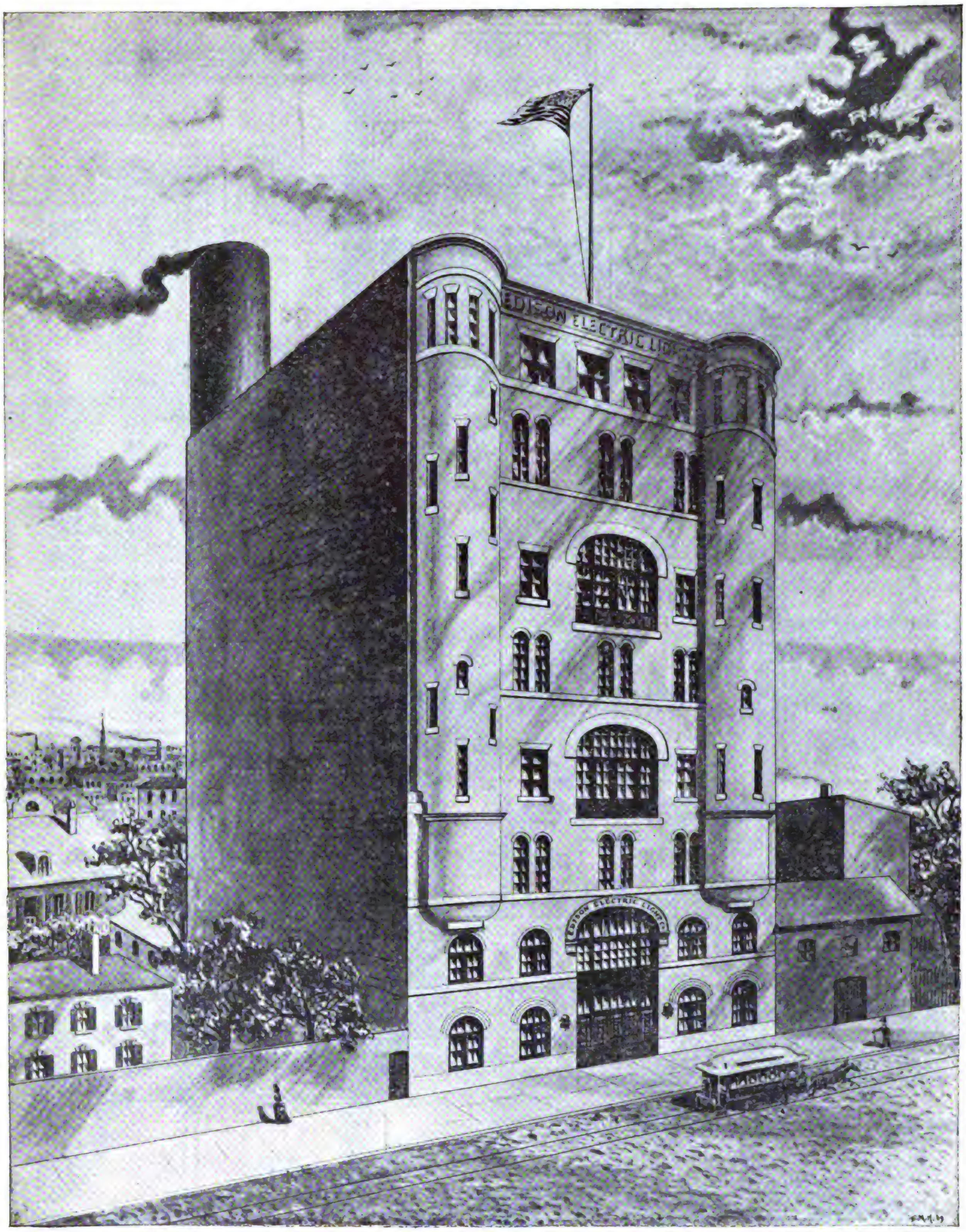
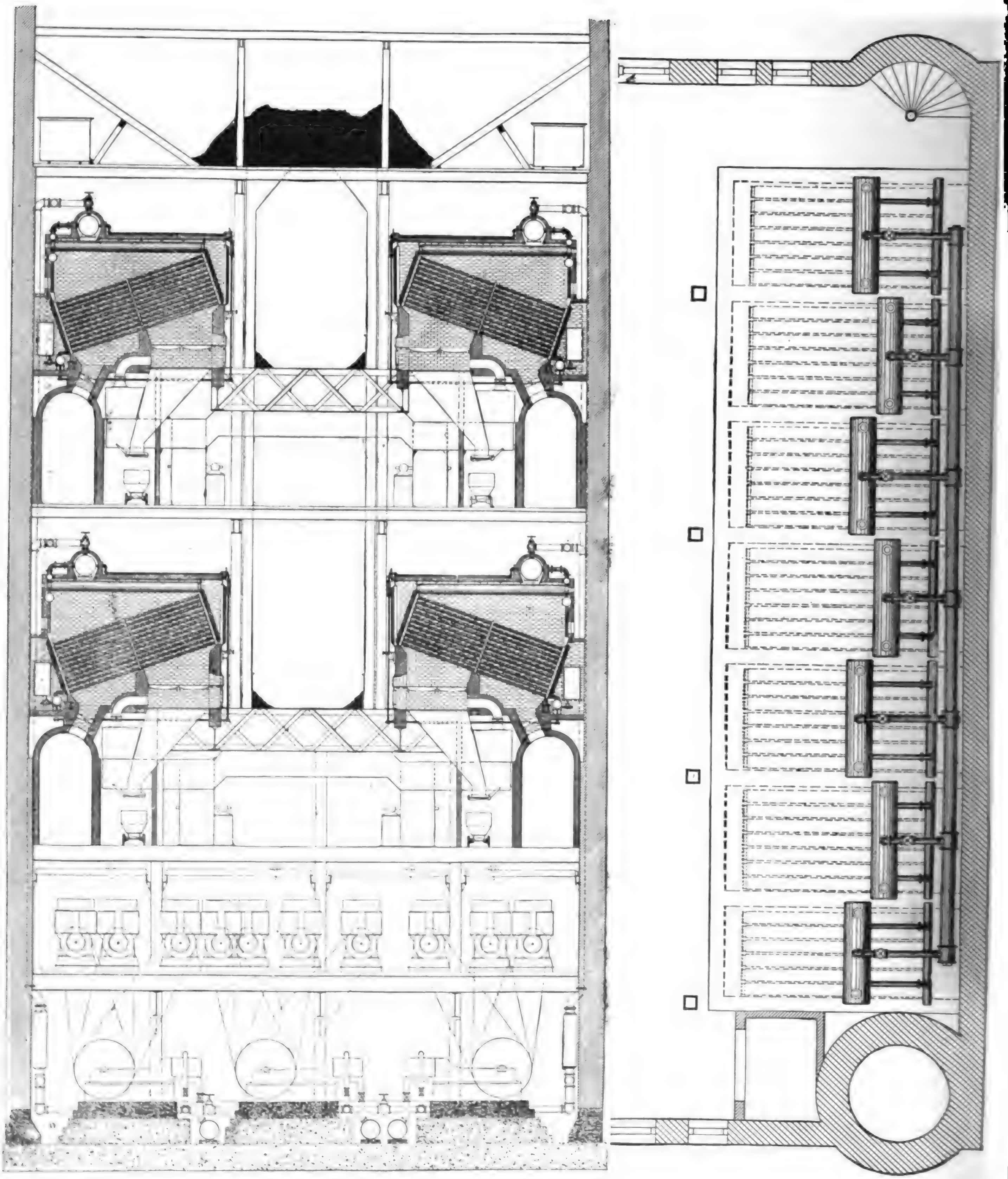


FIG. 1.—THE EDISON CENTRAL STATION, PHILADELPHIA.

500 h. p. each, are already running and three more have been ordered, to be delivered by November 1, 1890. They will then have a capacity of 67,500 lights. At the middle of the present month they had applications for, and had connected up, 49,807 lights, and the demand for service is steady and persistent. A large quantity of current is also being disposed of for motor service.

Economical steaming is an essential feature of such a plant, and the boilers constitute an element of importance. The company have now in operation three batteries of Abendroth & Root boilers of 1,000 h. p. each. The fourth battery of 1,000 h. p. of this make has been ordered, and it is to be ready by November 15. These boilers are well-known to our readers, having made their way into many electric light and power plants, and do not need extended description. In general design they consist of a nest of inclined water tubes connected at their front and rear ends with a series of horizontal overhead drums, the water level



FIGS. 2 AND 3.—SECTIONAL VIEW OF EDISON STATION, PHILADELPHIA, AND BATTERY OF BOILERS.

being carried at the middle of the drums and the fire being applied under the front, raised ends of the tubes. The action of the fire causes an upward, forward flow in the tubes, the water thus forced from the tubes into the front end of the horizontal drums being replaced by a downward flow from the rear end of the drums. The success of the boiler is based upon the thorough operation of this principle of continuous circulation and upon the scientific accuracy of the various details. Fig. 3 shows diagramatically one side of the boiler room of the Philadelphia station equipped with the Abendroth & Root boilers. When complete the plant will be one of the largest in the country.

ELECTRIC POWER-TRANSMISSION IN MINING OPERATIONS.[1]

BY H. C. SPAULDING.

IT is the object of this paper to present briefly some of the work already done towards the application of electrical apparatus to mining processes, as well as to embody some practical suggestions and statements from those who have had personal experience in the operation of such apparatus.

Following the natural order of operations, let us consider drilling and cutting machinery in the first place. Fig. 1 shows the drill manufactured by the Diamond Prospecting Company of Chicago. This is designated by them as a Type "R" machine, nominal capacity 300 feet, and equipped with a motor of 3 horse-power, rated capacity. The total weight of the machine, set up and running, is 1,000 pounds, and the heaviest piece, when taken apart for shipment, weighs about 170 pounds. The machine is mounted on trucks fitting the gauge of the mine-track for easy handling, and can be taken apart in fifteen minutes, and put up in a half-

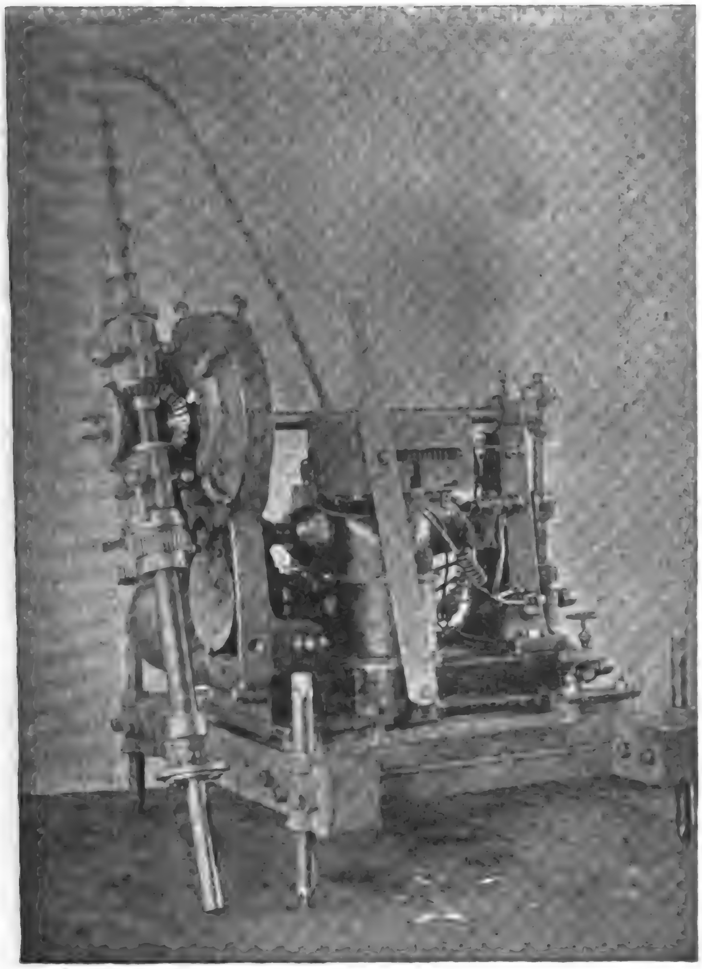


FIG. 1.—THE "DIAMOND" ELECTRIC DRILL.

hour without difficulty. The drill swivels so that holes can be put in at any angle, and can be operated in a space giving 5 feet in the line of the drill rods.

The general arrangement of electrical and mechanical parts is sufficiently evident from the illustration, though the pump is hidden by the pedestal on the right. This is operated by the horizontal shaft driven by the bevel-gearing shown, and supplies a constant stream of water to the diamonds through hose connected with the top of the drill-tube. In a recent test on a granite boulder, hole 1⅛ inches in diameter, with slow speed, this drill cut 22 inches in 40 minutes. When set up in the mine and working on hard compact limestone, it cut the rock at the rate of 1 inch per minute, not including stoppages for changing the rods.

The general principle of construction of most electro-dynamic machinery provides us with a rotary motion, which it is necessary to transform to a reciprocating in order to obtain drills of the Rand or Ingersoll type. Any such transformation, however, entails a considerable loss of power, and we are happily relieved of this necessity by recent inventions which are based on the general characteristics of the solenoid. Such a drill was recently constructed under the patents of H. N. Marvin, of Syracuse. Mr. C. J. Van Depoele, of Lynn, Mass., was one of the first to appreciate the demand for this class of apparatus, as well as the possibilities of the principle involved; and a large factory is under course of construction by the Thomson-Houston Company, which will be especially devoted to drilling and pumping machinery of the reciprocating type.

Many machines have been placed upon the market, in recent years, for making the under-cut in soft-coal mining. Several of them have met with a certain degree of success in clean and easily-worked veins, steam or compressed air (generally the latter) being the operating force. Perhaps the most successful of these machines has been that manufactured by the Jeffreys Mining Machine Company, of Columbus, Ohio. Appreciating the advantages of electric power for this class of work, Mr. Jeffreys was not slow in adopting a motor, and has used a number of those manufactured by Foree Bain, the coal-cutter being modified somewhat to utilize this power to the best advantage.

In the opinion of many practical coal-miners, the principle of the rotating drill has many points of superiority in under-cutting machines, and the result of considerable experimenting and outlay in this direction by the Hercules Mining Machine Company, of Pittsburgh, has resulted in a machine embodying a series of drills operated by a Tesla alternating motor, the power being transmitted by a belt and the current being supplied to the motor by three cables.[1] When in operation, the cutter is clamped upon rails parallel with the face of the coal, being shifted along this track after each cut, ready for another. Compressible springs are wound upon each drill-rod, and serve as conveyors for the coal-dust cut out by the drills.

A machine also embodying the boring principle, though entirely different in its mechanical and electrical design, has been devised. A Thomson-Houston motor of a special type is used in this machine, current being supplied from the main entry-wires (which may also be used for lighting, haulage, and pumping) by flexible wire-covered cables.

The series of cutters (nine in number, each 4 inches wide) is so arranged as to cut close to the wall beside which the machine is placed, and within ⅛ inch of the level of the floor.

Although the weight of the apparatus complete is less than 1,400 pounds, no clamping is needed, as the drills will "pull themselves into the coal," with only the friction of the machine behind them as it rests on the floor.

Having thus briefly examined the present electrical apparatus for boring into ore or coal, so that it may be blasted out, let us see what means are at disposal for hauling it out of the mine, or from one point to another under the surface.

To Mr. W. M. Schlesinger, of what was, at the period referred to, the Union Electric Company, is due the honor of constructing the first electric locomotive for strictly mining uses in the United States. This was of 35 horse-power rated capacity, and was put in by the Lykens Valley Coal Company, Lykens Valley, Pa.

A series of iron rails were joined together to form a conductor for the current, which, after passing through the motor, completed its circuit to the generator by the track-rails, which were connected also by copper wires.

A locomotive of 40 horse-power capacity has been for some past in operation at the Hillside Coal Company's Erie Colliery, near Scranton, Pa.

The power-plant consists of a standard Armington & Sims engine capable of developing 60 h. p., and a 50 h. p. Thomson-Houston generator wound for a current of 220 volts potential, and the necessary appliances for its operation. The engine and dynamo room at the top of the shaft are in charge of the engineer and assistant, who operate the other mining machinery.

From the dynamo to the foot of the shaft the current is conducted by No. 0 Clark wires, enclosed in gas-pipes to protect them from damage. From the bottom of the shaft the wires are carried overhead, about 12 inches outside of the low rail of each track, and are suspended from an insulator specially designed for this class of work, the construction of which can be readily seen from the accompanying illustration, Fig. 2.

The locomotive shown in the illustration, Fig. 3, embodies many new features in motor construction and general design, and, under practical test, has shown that it is particularly adapted to the work required of it. It is built for a 3 feet gauge, and is of the following dimensions: Length over all, 9 feet 7 inches; width, 5 feet 3 inches; and height, 5 feet 6 inches. This last dimension can be considerably reduced by placing the rheostat at one end instead of on the top, as has been done in the present instance. The weight of the locomotive is 10,500 pounds, to which 1,800 pounds has been added to increase traction. The motor employed is of the type "G" railway motor of 40 h. p.

The locomotive is run by one man, who is assisted by a boy in making up the trains and turning the switches. It displaces seven

1. Abstract of a Paper read before the Amer. Inst. of Mining Engineers, New York, Sept. 30.

1. For a full description of this machine see THE ELEC. ENGR., Aug. 20, 1890.

mules and three drivers. During a period of 11½ days the average number of cars delivered at the shaft bottom by the locomotive was 559.5, against 526.95 per day delivered by mule haulage, much time being consumed by waiting at the bottom of the shaft for empty cars. Thus far, the locomotive has shown that it will increase the daily output to 700 cars per day.

The Thomson-Houston Company has now under construction for another Pennsylvania mine a locomotive of 60 h. p. capacity, which (although of the same general type) will be so modified in design as to stand only 4 feet in the clear, above rails, the gauge being 3 feet. The same general plan is applicable to mine tramways of even 12 or 18 inches gauge, suitable for narrow entries, such as are found in some of the Western gold and silver mines.

For hoisting purposes, we may have a variety of forms and sizes, from a 3-horse whip, for hoisting small buckets, to a machine capable of operating a full-sized cage under its maximum load. Fig. 4 shows a hoist of the Webster, Camp & Lane make equipped with a motor, for use in the Ashland iron mine, at Ironwood, Michigan. In the Castle Gate mine, Utah, a 35 h. p. Lidgerwood Thomson-Houston hoist is located about 1,000 feet inside the main entry, for handling the trains at that point.

In pumping machinery, a peculiar apathy seems to exist among prominent manufacturers as to the demands of this kind of work. There are, of course, innumerable cases where centrifugal and plunger pumps have been belted or geared to motors to accomplish certain objects; but the Goulds pump is the first of considerable size which, to the writer's knowledge, has been designed, with special reference to operation by electric power, and which is in itself a mechanical unit, so to speak. This pump is manufactured by the Goulds Manufacturing Company, of Seneca Falls, N. Y. Tests were made, with a view to determining the general fitness of the type for deep mining pressures, and the results have been considered sufficiently satisfactory to warrant the designing of a standard line of pumps of from 50 to 500 gallons per minute capacity.

The pump as shown, consists of three vertical cylinders, within which are three single-acting plungers, their cranks being hung from the main shaft at 120° angles, in order to produce the most even application of power. In addition to this class of pumps for general hydraulic work, the Van Depoele type of reciprocating-engine is being adapted to a sinking-pump which has, as yet, not been sufficiently tested to warrant further mention here.

I need hardly mention the subject of ventilating apparatus, as the application of motors to revolving-fans of any kind is a mere question of belts or gears, though the fact that the fan, with its motor, may be located at any desired point within the mine, with an expenditure of power hardly greater than would be necessary outside, has a marked bearing upon the general arrangement and efficiency of ventilating systems.

The question of lighting, also, though a most interesting one to the engineer and operator, hardly falls within the scope of this paper. It is sufficient to call attention to the fact that the same wires which furnish current for a part or all of the apparatus enumerated above, will make the interior of the mines as light as day, and give a beneficial result, not only directly in the amount of product, but indirectly in the satisfaction and comfort of the men. This is not theory, but has been demonstrated to the satisfaction of all concerned, and in cases where there was, at the start, among the miners themselves, a hearty and bitter opposition to the new system.

A power-plant just erected by the Pleasant Valley Coal Company, at Castle Gate, Utah, is, in many respects, a model of its kind. It has a capacity of about 750 h. p. of generating machinery, which will be used for furnishing current to electric coal-cutters, drills, pumps, haulage engines, ventilating-fans, etc., the entire power needed for the various mining operations being transmitted electrically. As this is the first plant of such magnitude employing electric apparatus to the exclusion of other systems, the result will be watched with interest.

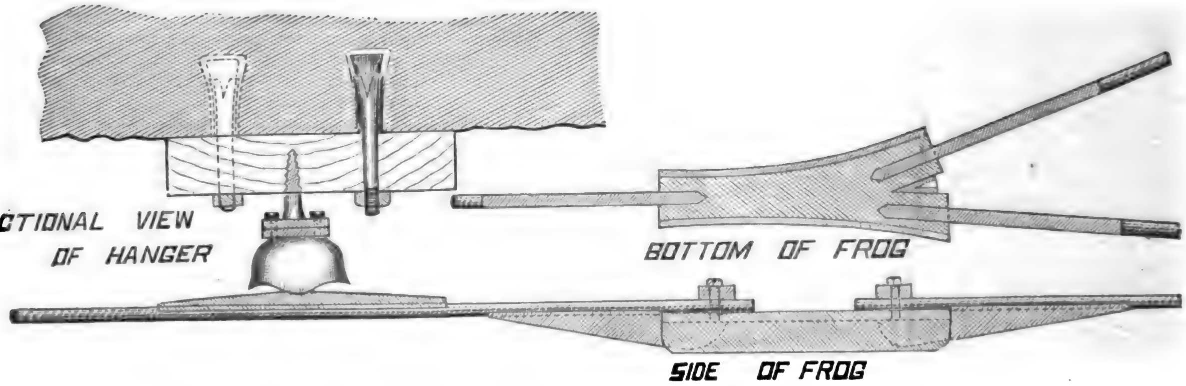


FIG. 2.—DETAILS OF SWITCH, ELECTRIC ROAD, ERIE COLLIERY, SCRANTON, PA.

THE ELECTRO-MAGNETIC RECIPROCATING ENGINE.[1]

BY CHARLES J. VAN DEPOELE.

ONE of the recent developments in the electric line is the perfection of a new electric-magnetic reciprocating engine.

For years past, and, indeed, ever since electricity was first used to magnetize an iron bar by means of a coil of wire, the idea of producing a reciprocating motion by the electric current has been entertained, and many unsuccessful attempts have been made to construct and operate such machines.

Not until the invention and construction by the writer of an electric generator which would give currents rising and falling at a definite speed, could the current be sent to the coils of a reciprocating engine, there alternately attracting and repelling its plunger. In this apparatus, however, as will be seen later on, the rising and falling of the current is produced in such a way that it is absolutely certain that no spark is produced either in the machine or in the generator producing the current. The current is caused to rise and fall in closed circuits, and actuates the plunger of the reciprocating engine with a speed corresponding absolutely to the speed of the defined rise and fall of currents produced by the generator. Thus, the generator can be caused to produce, say, 400 pulsations of current a minute, or it can be made to produce either a higher or lower number than this, so that the engine's speed can be regulated according to the size of its piston and the work it has to do.

The engine itself is a simple piece of machinery, consisting of two or more coils of copper wire, or solenoids, incased in an iron envelope protecting them from outside injury. Within these coils is placed a brass tube, and within this an iron plunger, capable of moving to an fro under the action of the currents in the coils. To the end of this iron plunger is attached a piston-rod, similar to that of an ordinary engine, and to this is attached the hammer, drill or whatever tool is to be operated by the engine.

It will readily be seen that one of the first applications of these machines will be to rock-drills, such as are now in use in nearly all mining and rock-work, for quarrying, prospecting, etc. The simplicity of the machine lends itself most readily to this application, as it will be seen that there are no movable parts on the whole machine, except the plunger and piston-rod carrying the tool.

There are no valves, as in steam-engines, no switches, no make and break of the circuit, and no exposed current-carrying parts, so that the whole can be handled with safety and without any skill above that of common laborers. By turning on the switch the machine is started; by turning off the current, it is stopped. There is absolutely nothing to be done to the machine, except occasionally to pour in a few drops of oil, to lubricate the piston and its rod.

For ordinary mining-work the drill is mounted on a tripod similar to that now in use with the steam and air-drills which are well known to-day, or it can be attached to horizontal bars or to vertical columns; in fact, it lends itself to absolutely the same work that has been done heretofore by the air and steam-drills. It will work in any position, from horizontal to vertical. The weight of these drills will be approximately the same as that of the steam or air-drills of the same capacity, and everything is so arranged that the men accustomed to work the latter machines will find no difficulty in operating the new electric drills.

1. Abstract of a paper read before the American Institute of Mining Engineers, New York, Sept. 30.

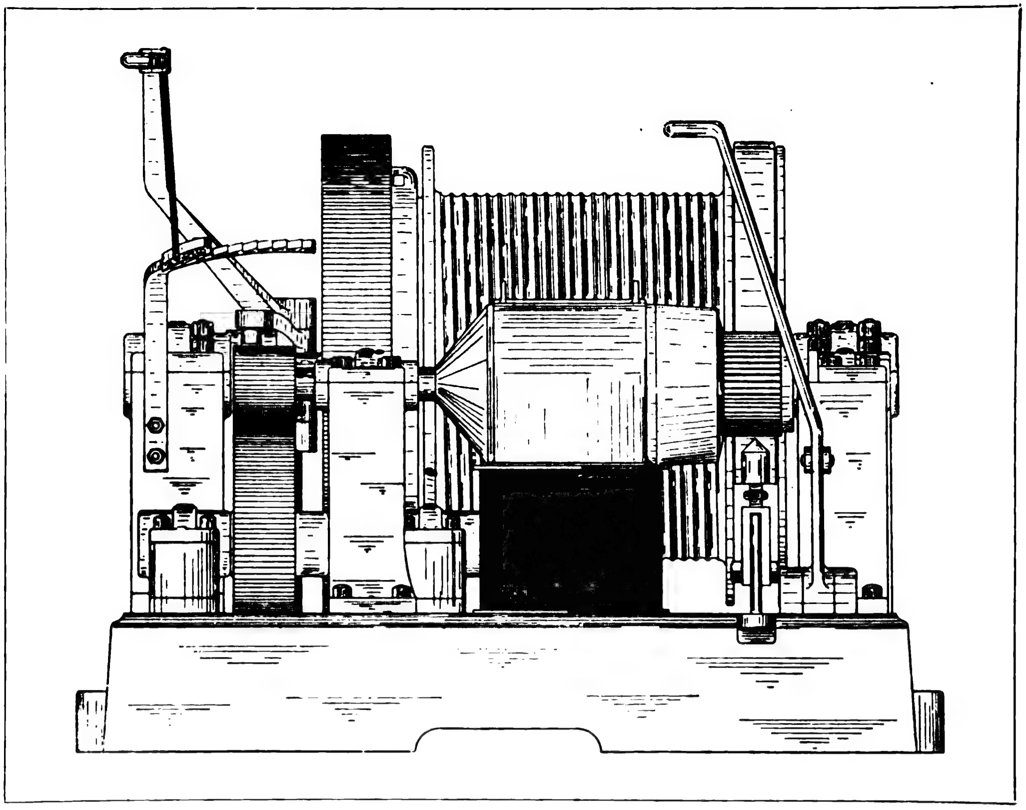


Fig. 4.—Electric Hoist, Ashland Mine, Ironwood, Mich.

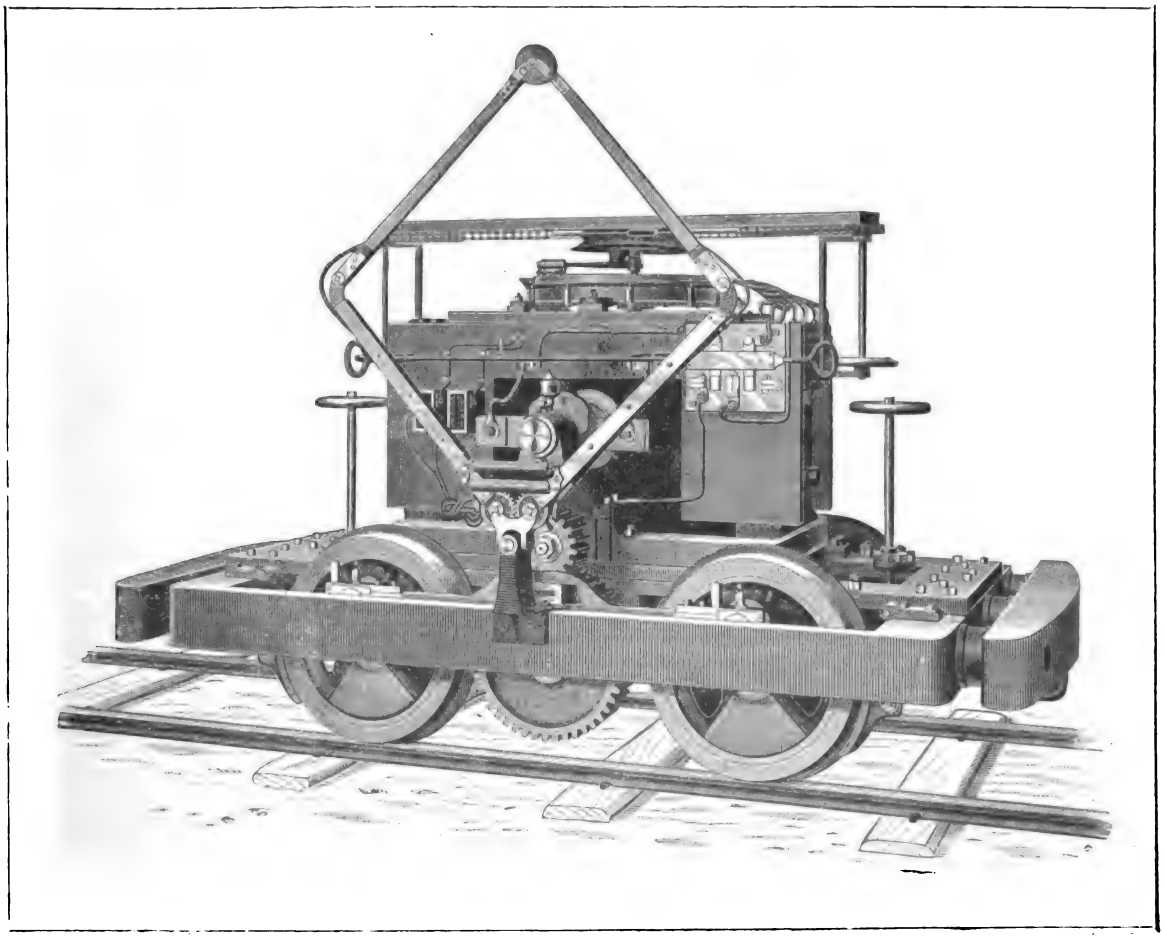


Fig. 3.—Electric Locomotive, Erie Colliery, Scranton, Pa.

THE BALL AND NORTON "MONARCH" MAGNETIC SEPARATOR.[1]

BY C. M. BALL.

THIS machine is the joint invention of Mr. Sheldon Norton, of Hokendauqua, Penna., and the writer, and has been patented in the United States, Canada, and other countries.

The figure shows a longitudinal vertical section of the perfected Monarch ore-separator, adapted for separating fine ore; another size is adapted for cobbing ore of the size of stove, or chestnut-coal. The two designs are identical in principle, and vary from each other in minor details only.

The apparatus consists of a partially closed chest, having an opening at *f*, from the feed-hopper *h*, through which the ore is delivered to the machine from an ore-pocket or storage-bin provided with means for regulating the flow of ore, so that, when the machine is in operation, the hopper is kept always full. Other openings are provided for the discharge, at *t*, of tailings; at *m*, of middlings; and at *c*, of concentrates; also, at *e*, for allowing free ingress of air to the chest at that point, and at *s*, where a powerful exhaust-fan is connected. The openings at *t* and *m* are kept sealed against ingress of air at those points by means of the hinged and weighted valves, *v*, *v*, which discharge the products from the hoppers *p* and *k* continuously, and in the same proportion as received from above, when a sufficient weight has accumulated upon the inside to cause the contents of the hoppers to leak by the valves.

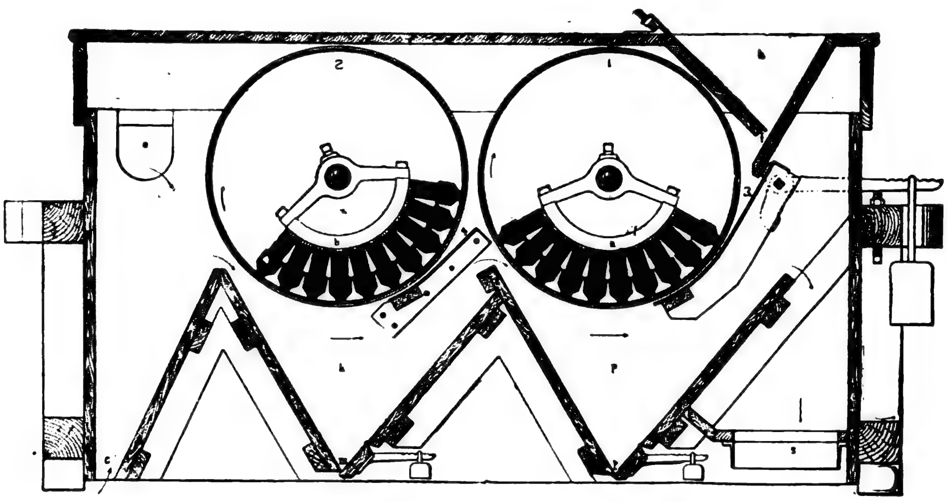
The machine is also provided, as shown, with two drums, 1 and 2, turning upon the shafts, *i* and *j*. These shafts, together with the magnets, *a* and *b*, which they also serve to support, stand still, while the drums may be rapidly revolved around the magnets and out of cantact therewith.

It will be noticed that the magnet occupies a section of the drum, the proportions being such that, approximately, one-third of the periphery of the drum is within the influence of the magnetic field, while the upper two-thirds is outside of the field and removed from the magnetic influence. The magnet is so constructed as to present a series of poles of alternately opposite polarity near the inner surface of the drum. In accordance with the well-known phenomena of magnetic attraction, which in the case of powerful magnets is exerted at a considerable distance from the magnetic poles, any magnetizable matter brought near the outer surface of the drum, within the arc covered by the magnet. will be powerfully attracted and drawn into firm contact with the outer surface of the drum. These drums are composed of a non-metallic and neutral material, such as wood, paper, etc., and they turn in the direction indicated by the arrows near the top of the drums.

Just below the feed-hopper an apron of neutral metal, 3, is arranged, curving downward and forward in the direction of the rotation of the drum, its lower portion describing a short arc concentric to the surface of the drum. This serves as a chute to direct the stream of ore falling from the feed hopper within the influence of the first two or three poles of the magnet. A similar but somewhat shorter apron, 4, is arranged in like relation to the second drum and magnet, *b*.

Attention is called to the provisions for applying and directing the air-current, which fulfills an important function in the process of separating ore as developed in this apparatus. The air may enter freely at the openings *c* and *e*, and is drawn through, and out of, the chest by the action of a powerful exhaust-fan connected at *s*. The air which passes through the chest containing the drums and magnets must, of necessity, follow the course indicated by the arrows in the space below the drums.

When the machine is put in operation the magnets are excited, the drums are revolved in the direction before indicated, the air-current is established through the machine in a direction opposite to that of the rotation of the drums, and ore is supplied through the feed-hopper which is kept always full. The ore passes down the chute under the first drum, and, as soon as it comes within the influence of the magnet, the magnetizable portions are drawn into contact with the drum and through friction upon its surface take on the forward movement of the drum. At this stage, a curious and important result takes place. The particles of ore in contact with the drum opposite one of the poles of the magnet stand on end, forming tufts, spreading away from each other at their outer ends. As they are drawn along, however, by friction against the moving drum, when they get to a point midway between two poles they lie down flat against the surface of the drum, and, as they are drawn still further along, they again stand on end—but this time the other end out. So, in passing through the magnetic field, they are tumbled end over end as many times as there are poles in the field. The result is, that every time they are reversed in position opportunity is afforded for any non-magnetic particles of gangue, which may have been entangled with the ore, to fall away from the tufts of magnetite; and this result is still further facilitated by the centrifugal tendency and by the counter-current of air.



THE BALL AND NORTON MAGNETIC ORE SEPARATOR.

When the ore reaches the limit of the arc covered by the magnetic field it is no longer attracted, and takes on a tangential movement, which carries it away from the drum. It has now, however, passed the edge of the second apron, and, on leaving the first drum, comes within the influence of the magnet of the second drum, where similar operations are repeated, a portion being finally discharged as concentrate at *c*. The function of the second drum and magnet is to differentiate the product from the first drum into two portions, which may be conveniently designated as middlings, discharged at *m*, and concentrate, discharged at *c*. The middlings consist of particles of ore with adhering portions of gangue, which may require a little finer crushing to effect their mechanical liberation: or, they may consist in part of iron compounds having a smaller degree of magnetic susceptibility than the pure magnetite. The separation of the middlings from the mass delivered to the second drum may be effected in two ways: If the drums have the same speed of rotation, a weaker magnetism in the second magnet will allow these less magnetic particles to drop away; or, if the magnets have approximately the same force in the two drums, a higher speed of rotation of the second drum will throw these particles off by reason of the centrifugal force overpowering the centripetal magnetic attraction, the magnet having the smallest influence upon the leaner portions of the mass.

Modifications of this apparatus have been designed, which adapt it for use in conjunction with a stream of water mingled with the ore, so constituting a wet process.

The positive character of the functions above enumerated renders it possible to make an effective separation under the con-

1. Abstract of a paper read before the Amer. Inst. of Mining Engineers, New York, Sept. 30, 1890.

ditions of a very heavy supply of ore to the machine. The easy working-capacity of a machine having drums of 24 inches diameter and 24 inches working-face is from 15 to 20 tons per hour of ore granulated to pass 16- to 20-mesh screens.

The power required is from 1 to 1½ horse-power in electricity for each drum, and ½ to ¾ horse-power to drive the machine.

These machines have been applied to the treatment of a considerable number of ores. The most remarkable of these was the conversion of Port Henry Old Bed ore into a Bessemer ore, carrying Fe 71.10, P 0.037. This concentration was made from the crude ore, carrying Fe 58.7, P_2O 2.25, the Bessemer concentrate representing about 65 per cent. of the original mass.

MAGNETIC CONCENTRATION AT THE MICHIGAMME IRON-MINE, LAKE SUPERIOR.[1]

BY JOHN C. FOWLE.

HAVING had for many years the management of magnetite mines, and having noted the various admixtures, such as jasper, "green rock," actinolite, etc., that occur so frequently in the deposits and make the fine ore so difficult, as well as expensive, to sort by hand, I studied the different ways of mechanical sorting, but found none satisfactory—the universal objections being the expense, the small quantity that could be handled per hour, and the low grade of ore produced after all.

Careful investigations showed that neither dry nor wet concentration was the right process for us; and I finally studied the magnetic process. Not knowing of any magnetic separator in this country that would handle such large pieces of ore as I wished to treat, I looked abroad and found in Sweden the Wenström separator. One of these machines was brought to the United States and tested in New Jersey and other places. (See the papers of Messrs. Cook and Birkinbine, *Trans.* xvii., 599 and 728.) This original separator, having 15-inch face of drum, I brought to the Michigamme mines, and, no one having confidence in it, placed it in operation at my own expense. Finding that in this way large ore could be treated much better by magnetic separators than by hand, and with much greater enrichment of the product, I put up a small, crude mill with several series of screens, so as to size the material and treat on the separator the different sizes by themselves. This gave a still better product. None but the 15-inch separator was used. We shipped from this mill 11,000 tons of concentrates in 1889, a part of which, produced from crude 50 per cent. ore, contained 65 per cent. of iron, while the remainder, produced from crude ore running 52 to 54 per cent., carried 60 per cent. iron.

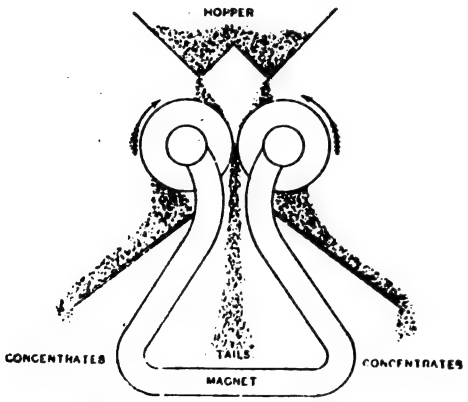


FIG. 1.—THE BUCHANAN MAGNETIC ORE SEPARATOR.

The experience at this mill shows that the fine powdered ore and the ore going through a ¼-inch screen, should never be allowed to fall directly on the separator, but should be carried near the separator by a belt on an inclined plane and attracted to the drum of the separator by the electro-magnetic force. It is almost impossible to feed this fine ore directly on to a separator in a sheet sufficiently thin to permit a satisfactory separation, because ore and rock overlying one another are bound together in the drum; but by feeding the fine ore by a belt up to the separator, the mass of material is agitated, and the ore flies to the drum and the rock falls, or remains on the belt. The greater the electric current which is carried on the separator, and the farther away from the separator the crude ore is when it enters the magnetic field, the higher will be the percentage of iron in the concentrates and the lower in the tailings. For instance, crude ore, containing 52 per cent. of iron and 0.324 of phosphorus, when treated directly on the separator, gave concentrates in one case containing 58 per cent. of iron and 0.215 of phosphorus; and in another case 60 per cent. of iron and 0.180 of phosphorus; while the same ore, treated by a belt-feed, not in contact with the separator, gave concentrates containing 67.07 per cent. of iron and 0.160 of phosphorus.

The fine ore that passes through the screen, is delivered to a swing-screen, from which it drops into several pockets, and is then fed by gravity to the Buchanan separator, Fig. 1. This separator also treats, independently of the crushed ore, all the previously-mentioned mine-screenings. These are fed to it direct from storage-pockets, without any preparatory crushing or sizing. The concentrate, or "ore," produced by the separator, is conveyed to railroad cars and loaded for shipment. The tailings are run over our Wenström separator, Fig. 2, to take out any remaining ore. The Buchanan separator is very well built; it has a much larger capacity than the small Wenström machine, and makes richer concentrates. It carries a current of 23 amperes, and is wound with heavy copper wire. The Wenström machine, on the other hand, can carry only 10 amperes, and is wound with wire of one-third the size. We keep the Wenström machine in use

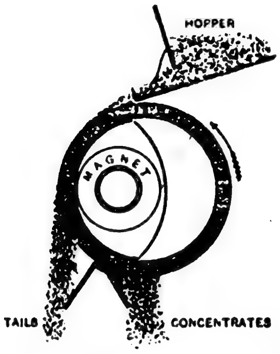


FIG. 2.—THE WENSTROM MAGNETIC ORE SEPARATOR.

only because we happen to have it. It is our original Swedish machine and is a good one—much better, in fact, than one which was built for us in this country, but which we do not use.

I consider the concentration of magnectic ores by electricity to be still in its infancy as to cost, capacity and quality. Our experience has been exclusively with separators having one or more drums, and I claim no knowledge of practice with other forms of apparatus. The many mills now in operation in the East will undoubtedly, during the present year, work out new methods for concentrating iron-ores, whereby the cost will be reduced and the output still further increased.

1. Abstract of a paper read before the Amer. Inst. of Mining Engineers, New York, Sept. 29, 1890.

THE COMPENSATION OF ALTERNATING CURRENT VOLTMETERS.[1]

BY J. SWINBURNE.

IN 1887 I had the honor of bringing before Section A several methods of compensating voltmeters and resistance-bridges for variations of temperature. Wires with different temperature coefficients were used, by which means errors from change of temperature can be avoided. Methods of compensating wattmeters for the errors inherent in them were also explained. The present communication relates to a somewhat analogous arrangement for compensating alternating voltmeters for changes of frequency.

It is much more easy to make a current indicator for alternating than direct currents, for troubles from hysteresis do not come in, and the slight tremble makes the moving part hang freely. If it is attempted, however, to use such an instrument as a voltmeter, the self-induction makes the reading far too low, and the error varies with the frequency.

To get over this trouble, a voltmeter may have a non-inductive, or nearly non-inductive, resistance put in series with its active coil. A coil with an adjustable iron core is then put in shunt to the active coil, this shunt coil having a very much larger time-constant. Though both coils have iron cores, they have open magnetic circuits, so they have practically constant coefficients of self-induction. When the frequency increases, the current through the whole instrument under a given pressure falls; but the back pressure of the shunt coil increases more rapidly than that of the active coil, so that it takes less than its share, while the active coil gets a larger share of the reduced current; the actual current, and therefore the reading, in it remaining constant. The instrument is calibrated with a direct current. An alternating current is then put on, and the core of the shunt coil regulated till the readings agree with those of the direct current.

1. Paper read before the British Association, Leeds, September, 1890.

ON WELDING BY ELECTRICITY.[1]

BY PROF. ELIHU THOMSON.

The purpose of the present paper is to call attention to some of the more prominent steps in the progress being made in the development of electric welding and metal working, it being understood that even while this present paper is in preparation, advances are taking place in the working out of details. It is not, therefore, intended to have this paper take the character of a complete statement, but rather that it shall be a brief review of some phases of the development of the art.

In this art, the foundation experiments were made about four years ago. The author had the pleasure of describing some of their results, particularly relative to electric welding, in a paper written in the latter part of the year 1886. The appearance of that paper aroused a considerable interest in the subject, which has continued from that time, and it is curious to note how it has caused the revival of early attempts to use the electric arc in metal welding or working, sometimes in conjunction with a magnet for displacing the arc and converting it into a blow-pipe of great intensity, the latter being a procedure due, it is believed, to Werdermann, in the early days of the production of electric arcs from dynamo machines.

It is not my present purpose to deal with any of these arc methods of electric metal work. Their practicability is doubtful. So far as is known to the author, there are no existing instances of the use in practice of the electric arc for welding, though numerous attempts have been made, which have failed from one cause or another.

The operations with which this paper deals are those in which the heating effect of electric currents traversing a solid metal conductor gradually brings the metal to the working temperature. This temperature is, in the case of easily fusible metals, much below a red heat, and is hence unattended with luminous effects, which, however, appear in the case of metals softened or fused with greater difficulty.

In order to distinguish this process, applied to the welding of metals, from the application of the heating effect of an electric arc for like purposes, it has been called the incandescent method of electric welding—a designation which is, in my judgment, misleading, for the reason that lead, tin, zinc, and other metals fusing far below the temperature of incandescence, are thus welded.

Electric welding occurs between pieces of all metals thus far tried, though the perfection of the joint obtained varies with the metals and with the conditions under which the work is performed. Many different metals unite each to the other, and in many cases the union is such as to possess a strength or tenacity equal to that of both, or of the weaker of the metals joined. In other cases it is not so strong, owing to wide differences in the physical nature of the metals or alloys, or in their tendencies to surface union. Perhaps the incipient alloying at the joint may affect the strength, according to the nature of the alloys possible to be thus formed.

It is proper here to correct an impression which has gained some currency—namely, that it is the extra resistance caused by the break or limited contact between the meeting portions of metal which gives rise to the heating in electric welding. While this limitation of contact surface undoubtedly hastens the heating at the joint, it is nevertheless a fact that a solid bar, joining the clamps of an electric welding machine, will be heated between those clamps to welding temperature, and may be upset by the approach of the clamps one toward the other. Indeed, this process is actually employed to upset collars on shafts, or to set or fasten in place, by a sort of riveting action, collars which have been placed as rings, more or less closely fitting, upon a bar or shaft. The real cause of the concentration of the heating effect at the joint, or between the clamps, is the relatively greater conductivity of other portions of the welding circuit, which circuit is usually composed of massive copper conductors, kept cool, in the case of large work, by circulation of water.

The present tendency in the construction of electric welding machinery is towards having its action in most respects automatic, so as to leave little to the skill or dexterity of the operator in charge.

The apparatus first used by the author consisted of an alternating current dynamo, feeding a comparatively high potential current to the primary coil of an induction coil or transformer, the secondary of which was made so large in section, and so short in length, as to supply to the work currents not exceeding two or three volts and of very large volume or rate of flow. The welding clamps were attached to the secondary terminals. This first type of apparatus has survived to the present day, and most of the apparatus is constructed on that principle, the secondary coil usually consisting of a single turn only.

The practical results are not very different, whether continuous currents or alternating currents are used, though it is to be noticed that in the discussion of Sir Frederick Bramwell's paper the actions of the two classes of currents were spoken of theoretically, to some extent, as different. It has been shown that in conductors of large section the tendency of alternating currents is to keep to the surface of the conductor or to flow in the part of it farthest away from its centre. This is undoubtedly true as a tendency, but how far this tendency will be allowed to develop itself will depend on the drop of potential in a given length of conductor, a circumstance which appears to have been overlooked in many of the discussions of this interesting question. In other words, if the fall of potential, as in welding, is, say, two volts in two inches of length of the bar welded or worked, the density of current will be great, even in the centre of the section of the bar, but of course much greater near the exterior. But the heating effect also requires to be greater near the exterior on account of radiation taking place at the outside surface. The practical result may easily be that there is really a uniform heating effect throughout the section of the bar; and without doubt the conditions could be selected to secure such a result.

In welding the ends of two bars, however, they are frequently rounded, and at the start meet only in the centre. In such cases, whether the current be alternating or continuous, the heating effect begins at the centre. A curious fact may here be mentioned. It is found that the distribution of the alternating current may easily be controlled by increase or decrease of self-induction at various parts of the section of the bar by the proximity of magnetizable iron masses. This principle has been applied in a variety of ways to govern the distribution of the heating effect, and also to effect the restriction of current to the weld in thick rings. This will be adverted to later.

The temperature resistance co-efficient is, in general, much higher in the case of simple metals than in metallic alloys. The conductivity for heat has also a decided influence on the heating, and the comparatively low heat conduction of iron assists the work materially. Brass of ordinary composition scarcely seems to become plastic at all before melting. Hence the joints made with it generally show, in part, a real fusion and not merely a softening. In cases where the pressure used is too great, the joint is obtained by the crushing up of the hot metal in a semi-granular state before fusion, but this joint is not generally so perfect as the other. Some of the bronzes, and notably the alloy called aluminum bronze, show some plasticity before fusion.

The behavior of copper in welding by the electric current may be noted. It is an example of a metal of very high conductivity for heat and for current. Naturally, to weld it electrically, the current strength required will be much greater for a given section than for metals of smaller conductivity. The heat produced escapes rapidly by conduction, and the low resistance of the metal requires a great current to be passed to cause it to heat. This is compensated for, in large part, by the fact that the copper requires a very low potential, or E. M. F.—less than a volt across the joint. The rate of energy-consumption being the product of the current used by its electromotive force, and the total energy consumed being the product of this by the time, it will be seen that if a copper weld be made, in a short time the losses by conduction and radiation from the joint can be kept down to a moderate percentage of the total energy. Copper, as is well known, becomes decidedly softened before melting, and is, therefore, often forged hot. Hence, joints may be made apparently without real fusion; or, in other cases, when a lighter pressure for forcing the pieces together is used, a real fusion of portions of the meeting ends may occur. While in the electrical welding process joints are obtainable with most metals without the use of any flux, it is not the less true that a flux is sometimes desirable for good work, particularly with those metals the oxides of which do not melt at the temperature of welding or union of the pieces. Thus a flux should be used with brass, which has a temperature of welding and union below that of the fusing points of oxide of zinc or of copper, while a flux is not an essential in the welding of copper, the melting-point of which is above that of its oxide. A peculiarity of the electric welding process, and one which renders it capable of forming joints, even where metals may be coated with oxides infusible at the temperature of fusion of the metals themselves, is the expulsive power exerted to remove metal sidewise from the joint, and thus bring unoxidized, clean surfaces into contact at fusing temperatures. It is this fact which more than any other accounts for the universal applicability of the process to metals and alloys. For example, the chief obstacle to the soldering or welding of aluminum may be the skin of alumina formed on its surface when hot, which not only protects the metal from further oxidation, but prevents its union with other pieces of metal. The alumina is only fusible at the highest temperatures, whereas the metal fuses at about a red heat. Let two pieces, however, be vigorously pushed together while softening at the joint; then the oxidized surfaces will be thrust aside outwardly from the joint, and the new metal of the interior of the pieces will come together in the cleanest possible state, and unite. The removal of the burr or excluded metal of the joint can be afterward effected with proper tools.

The uniting of iron and various grades of steel is, of course, the most important industrial use of any welding process, and

1. Abstract of a paper read before the British Iron and Steel Inst., New York, Oct. 3.

this is particularly true of an electrical one. The behavior of soft iron is particularly favorable to the welding operation. Its great plasticity before fusion renders its working and welding easy and simple. In the case of steel, for the higher grades of which, especially, the ordinary blacksmithing operation is liable to be very uncertain, the electric process is rendered easy and certain for all grades. When it is remembered that the exact conditions of current, conduction, and pressure at the joint may be made definite, and are perfectly under control, it is seen at once that, if the pieces are weldable at all, we can even establish an automatic control of the welding after these conditions have been once determined.

There are many kinds of work to which electric welding seems to be peculiarly applicable. It is now in use largely far the joining of sections of wire into one length, and its use for such a purpose is still extending. Joints are regularly made in wires, which are afterward reduced in diameter by the wire-drawing process, various metals, such as copper, iron, brass, &c., being treated in this way. In other cases the electric welding process replaces the twisted joint formerly made in galvanized telegraph and similar wires—the galvanizing operation either preceding or succeeding the making of such joints. Even the ends of wire cables are readily jointed, the resulting weld possessing a strength not much inferior to the cable itself, and probably about equal to that of any heated or annealed portion. The making of such joints requires, or course, special precautions, but the operation is quite simple otherwise. In the welding and coiling of pipe the electric method seems to be especially expeditious and useful. Coils of pipe are now made continuously, as section after section of pipe is welded on. There is no limitation to the length of pipe which may be so welded and wound as one coil.

The process seems destined to work a revolution in pipe coiling operations. A machine will soon be tested which is intended for welding sections of six-inch extra heavy pipe together endwise. The current developed in this machine may reach 70,000 amperes, though its normal work will demand somewhat less than this. Most of the details of this and the other welding apparatus thus far constructed and put to use have been devised and arranged by Mr. Hermann Lemp, to whom the greatest credit is due for the original character and effectiveness of the machinery itself. Lieut. W. B. Wood has also had in charge a number of special pieces of work in adapting the welding process to several important applications.

Somewhat akin to pipe welding is the making of armor-piercing shells (as devised by Mr. Wood) from sections of varied grades of steel and without screw joints. In the making of rings, links, bands, &c., the electric welding operation is particularly useful, and a number of machines specially designed for such work have been put into practical operation. Even rings of small diameters relatively to the weight of section of stock used, are made with facility, though at first it might be thought that the current would pass around the joint and through the solid metal of the ring, instead of the joint or cut ends pressed together. This is true in part; but the actual result is that only in very stout rings is there much heating outside of the joint, and then only enough to make the ring flexible, so that the ends of metal at the joint may be readily moved together. With the alternating currents used in electric welding, not only does the current take the path of least resistance in largest amount, but it also seeks the short path, or path of least counter induction or self induction, and therefore will not go around a ring as freely, other things being equal, as along a short, straight path through the joint at one side. Furthermore, if it be desired to check any flow around the ring still more effectively, we have only to introduce into the centre of the ring or link a magnetizable core of iron, which effects a great increase of the counter induction mentioned.

An important matter which may be mentioned in this connection is the facility with which the milder grades of steel may be manipulated in the welding by electricity. The advantage of the superior strength of the steel over puddled iron may thus be secured, which allows the use of a cheaper material, and less of it for a given strength. This remark applies forcibly to chain making, in which the substitution of low steels for iron secures the double advantage mentioned, with the other advantages of the electric process over the ordinary ways of working. Considerable attention has therefore been given to the development of machinery for chain work, and a small working apparatus has even been made, which takes a wire from a reel and turns out lengths of chain with electrically welded links; the operation being automatic throughout. A curious feature of electric welding work is that two or more welds may be simultaneously made in parallel. This fact is utilized in chain making, where two welds, one at each side of a link, are made simultaneously. There are not yet in industrial operation any chain machines using the electric process. This step, however, is reserved for the near future. A special heavy chain machine will soon be completed.

It will readily be understood that the heating effect of very heavy electric currents may be applied to other cases of metal working than welding. Thus, it may be used to heat pieces for soldering or brazing, an operation which only differs from welding in the use of a more fusible metal between the surfaces to be united. In many cases the advantages of control of temperature, quickness of heating, and convenience of holding the pieces will be found greatly in favor of the electric method. In fact, an electric brazing machine has been regularly in use for some time past for bicycle construction, while in other instances such welding takes the place of joints formerly made by brazing with the blow pipe. The application of the electric methods to many tinplate soldering operations is likely to become industrially, as it has been already experimentally, successful.

Among the operations which can be readily performed electrically is that of heating a rivet in place by current passed through it and heading it while hot. In numerous trials, it has been proved that short, straight sections may be used as rivets, and both heads formed simultaneously, either as projecting heads or as countersunk heads.

Considered in relation to automatic character, range of adaptibility, the convenience and cleanly nature of the work, the perfect control of temperature secured, and the uniformity of result, the electric welding and metal working processes are decided advances over the prior art, and seem destined to a wide application.

TESTING IRON.[1]

BY J. SWINBURNE AND W. F. BOURNE.

In practical work iron has to be tested as to its permeability and as to the loss by hysteresis. As regards permeability tests, the ordinary ballistic galvanometer method can, of course, be used; but a ballistic galvanometer is not a convenient instrument, and the method is too slow for practical use. It may, therefore, be of interest to describe the apparatus we use commercially. It is the development of a method devised in 1886. (See *Phil. Mag.*, July, 1887.)

The various samples of iron are obtained in the form of wire, and made up into rings, being wound on a former kept for the purpose, so that all the rings are alike as to dimensions. Before winding, the specific gravity of the iron is taken by weighing, and the specific resistance is measured. The ring is weighed to get the volume of iron, and is then wound with suitable primary and secondary wires.

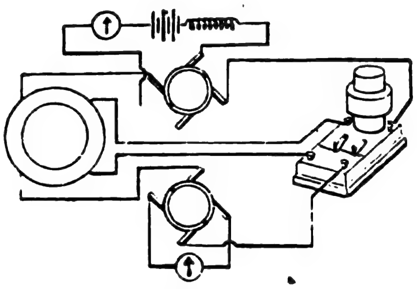


DIAGRAM OF IRON TESTING CIRCUIT.

The arrangement is shown diagrammatically in the annexed figure. The circuit from secondary cells is led through an adjustable resistance, then through an ammeter to a commutator, resembling Brillouin's, which is driven by a belt from any shafting that may be near. The circuit is led through the primary to an induction box to the ring under test, and then back to the commutator. The circuit is then led back to the cells. The induction box consists of a primary coil, standing on end, and a number of secondary coils arranged so that the mutual induction is the same for all of them. The secondary coils are led to buttons, and the switches include them by ones or tens, making the readings in steps of one per cent. of the highest. The primary of the sample ring is in series with that of the induction box. The secondaries are coupled so as to oppose each other, and arranged in circuit with a second commutator; a Varley, or, as it is more often called, a Deprez-d'Arsonval galvanometer, being inserted in the circuit. The two commutators are, of course, on the same spindle. The adjustment of the induction box was carried out as follows: The coils were roughly calculated to give a mutual induction a little in excess of a convenient round number per turn of secondary. A cylinder of a known diameter with a known number of turns per centimetre in the primary, and a known number of turns in the pilot coil, was taken, and put in the place of the sample ring, and its mutual induction measured with the induction box. To allow for the error due to the shortness of the cylinder of the standard coil, it was slipped out of the pilot coil, and moved exactly half its length in a direction along its axis, and a new reading taken. This reading gave the error due to the ends of the cylinder. A shunt was then put across the

1. Abstract of a Paper read before the British Association in Section A, Leeds, September, 1890.

primary induction box, so as to make the readings come out in microhenrys.

To test a sample of iron all that is necessary is to alter the mutual induction by steps, and to bring the galvanometer to zero for each step by means of the adjustable resistance. As the galvanometer is dead-beat, the readings can be taken in a few minutes.

We use the same rings as for the permeability test, but do not employ the secondary wires. The loss of power at various frequencies and inductions is taken with a wattmeter. It is sometimes supposed that a wattmeter cannot be made with little enough self-induction to read accurately. If there is much self-induction in the pressure or shunt circuit, the reading will be lower than that with a direct current if there is no self-induction in the circuit in which the waste of power is to be measured; but if the current is behind the pressure, as in measuring the loss in iron, the wattmeter may even read too high. We therefore designed a special instrument, which was made for us by pupils of the London College of Electrical Engineers. The current coils are fixed, and the moving coil is suspended by a fine wire, with a fine spring at the foot, to take the electricity out again. The moving coil has few turns and a little self-induction, and a large non-inductively wound resistance is in series with it. This wattmeter can be read with a mirror, if desired; but with 2,900 ohms in series with the pressure coil, it gives a torsion of 2° per watt on a non-inductive resistance. The series resistance is not wound with a looped wire as is usual in resistance boxes, because this method is not good, the insulation being apt to break down. A single wire was therefore used. When one layer was wound, the bobbin was reversed in the lathe, and the next layer wound in the opposite direction, a thin layer of insulation being put between the layers. This method secures absence of self-induction, and good insulation, as the beginning and end of the coil are kept well apart. The readings are taken by bringing the index back to zero by turning the suspension, so that the mutual induction of the coils is zero, as the coils are at right angles.

SOCIETY AND CLUB NOTES.

THE BRITISH IRON & STEEL INSTITUTE AT THE EDISON LABORATORY.

Friday last, Oct. 2, was largely given up by the mining engineers now visiting this city from Europe, to electrical matters, and a morning devoted to the discussion of electrical subjects and the inspection of various electrical plants and institutions was followed by an afternoon at the Edison Laboratory. About 200 visitors were expected, but when the party left West Twenty-third street and mustered at the Jersey City depot for the special Llewellyn Park train, it was found to muster no fewer than 500, a large proportion being ladies. The gathering included members of the British Iron and Steel Institute, the kindred French and German bodies, and the American Societies of Mining, Civil, Mechanical and Electrical Engineers. The train arrived at Llewellyn Park about 1:45, and lunch was hospitably provided by Mr. Edison in the laboratory library. Owing to the unexpected largeness of the crowd, it was impossible to serve all there at once, but good nature prevailed, and in an hour everyone had lunched and got down to the work of sightseeing. It is but truth to say that Mr. Edison himself proved far more attractive than his beautiful laboratory, and that he was surrounded all the time by clusters of ladies and gentlemen desirous of the honor of an introduction and a few words. But the various departments were not neglected, and the workshops, dynamo room, phonographs, electrical department, &c., &c., were curiously examined. During the afternoon, the ladies were given a drive in buggies through the lovely Orange Mountains. Before leaving all gathered together again in the library, where Sir John Kitson, president of the Institute, thanked Mr. Edison, in its name, for the pleasure he had given them all. After three cheers for Mr. Edison the party left the laboratory and took the return train at 5 p. m.

BROOKLYN INSTITUTE—DEPARTMENT OF ELECTRICITY.

Owing to the fire in the Institute building on September 12th, meetings of this department will for the present be held in the lecture hall of the Union for Christian Work, 67 Schermerhorn street, near Court street. A course of general lectures on the science of electricity will be given during the coming season. A course of lectures on technical electrical subjects will also be given. Eight regular meetings of the members of the department will be held for the discussion of special subjects and the demonstration of the action and use of electrical apparatus and appliances.

There will be exhibits of electrical apparatus and appliances as follows:

1. Batteries of various forms and kinds.
2. Telegraphic, telephonic, phonographic and graphophonic apparatus.
3. Electric lighting appliances.
4. Electro-motors and kindred apparatus.
5. Electro-metallurgical apparatus and processes.
6. Electrometers, galvanometers and kindred apparatus.
7. Electro-medical and electro-surgical apparatus.
8. General exhibit covering all branches of electricity.

The meetings of this department will be held on Friday instead of Saturday evenings as previously. On Thursday, October 2d, there will be an important business meeting of the members of the department. On Friday, October 10th, a lecture will be given, the subject of which is announced later. On Friday, October 24th, will be given a lecture by Schuyler S. Wheeler, Ph.D., on "Certain Applications of Electricity," with illustrations, and on Friday, October 31st, there will be an exhibit of electric batteries by members and other electricians. The phenomenal success of this department last year bids fair to be eclipsed by that of the coming season.

The next meeting of the department will be held in the Lecture Room of the Union for Christian Work, Friday, Oct. 10. At this meeting a paper will be read by Mr. C. A. Robbins on "The Engineering Difficulties Connected with the Recent Destruction by Fire of the Western Union Telegraph Company's Main Office in New York City."

As this fire completely destroyed the company's New York plant, its rapid recovery surprised the whole country, and Mr. Robbins being among those who disentangled the wires he will no doubt make the subject very interesting.

DINNER OF THE NEW YORK ELECTRIC CLUB.

In order to signalize the beginning of its winter season, the New York Electric Club gave a dinner at the Club house on Oct. 2, at 7 P. M., when about 120 gentlemen sat down to table, the whole floor occupied by the parlors and dining room being turned into a handsome banqueting hall. The dinner was served by Mazzetti in excellent manner. At the head of the table sat President Madden, supported right and left by officers and guests of the Club. During dinner much interest was taken in the music transmitted audibly to all, from the telephone exchange in Cortlandt street, the receivers being placed in the large electroliers, only the resonators showing. Enthusiasm was also evoked by the sorbet which was served in moulds like incandescent lamp bulbs and by the ice cream which took the form of a telephone set, complete and correct enough in every detail to pass as a dangerous infringement.

The hall of the Club house, it may be mentioned, was ornamented by a beautiful floral double carbon arc lamp, mounted on a base of flowers, upon which were the words "Science," "Progress," etc. This was the gift of Dr. De Lery.

The evening, after dinner, was whiled away with a programme of infinite variety. Gen. O. E. Madden, as President, first made made a brief and felicitous speech of welcome; he was followed in quick succession by ex-President Henry C. Davis, Judge Taylor, of Indiana, Grosvenor P. Lowrey, Gen. Greeley, and W. D. Sargent, president of the National Telephone Exchange Association. Then came Angus Hibbard with a song, and Mr. F. Z. Maguire with some original stanzas hitting off humorously the merits and idiosyncracies of the more modest members of the Club. Mr. Alec. Patterson also spoke with such eloquence that a quartette had to sing two or three times before equanimity was restored. Mr. E. T. Gilliland, late president of the Club, made a few earnest remarks, and to him suceeded the Hon. C. Maclaren, ex-M. P., and a nephew of John Bright, whose fervid expressions of good will and esteem were returned to him ten fold in applause and cheers. Mr. C. Dutton, Dr. Otto A. Moses, Capt. Zalinski, U. S. A., Lt. Veeder, U. S. N., and C. L. Thayer, also were required to confirm their reputations as after dinner orators.

Letters and telegrams of regret were read from Dr. L. Waldo, U. S. Senator Plumb, Abram S. Hewitt, J. I. Sabin, T. B. Doolittle and J. J. Dickey. After the regular programme, the "bars were let down," and joviality unrestrained took possession of the place until the small hours of the morning. The Club has never given a more brilliant, more successful or more perfect entertainment than this.

CONTESTING FRANKLIN'S WILL.

The bequest by which Benjamin Franklin left to each of the cities of Boston and Philadelphia, in 1790, the sum of £1000 sterling to be loaned out at 5 per cent. to deserving young married artificers is being disputed in the courts by his descendants. In Boston the fund has reached $400,000 and in Philadelphia, $100,000. The contest is based upon several grounds, the most important of which is what is known as the rule of perpetuities in common law. The law does not provide for the vesting of a legacy beyond the period of twenty-one years after the lifetime of the legatee, except funds devoted to charity. It is distinctly alleged that Franklin's plan did not contemplate charity from the fact that interest was charged on the loans. The claim is also raised that the purpose of the testator has not been fulfilled, owing to the apathy and negligence of the trustees, both in Philadelphia and Boston.

LITERATURE.

Practical Electrical Engineering: A Complete Treatise on the Construction and Management of Electrical Apparatus as Used in Electric Lighting and the Electric Transmission of Power. By W. W. Beaumont, C. H. W. Biggs (Editor), C. Capito, G. Kapp, A. Reckenzaun, P. Sellon, J. Swinburne and H. Swan. London, Biggs & Co.; New York, J. A. Penman. Published in 18 monthly parts, 10 x 13 in. Price, 75 cents per part.

THE literature of electricity has during the past ten years increased at such a rate that but few can hope to keep pace with it and this is true as well of periodical literature as of that issued in book form. But in spite of this, complaints are frequently heard of a lack of what is termed "practical information," such as will enable the student to design and carry out actual construction according to the best practice of the day, and, on the other hand, will afford the practicing engineer a ready hand-book of reference. To afford such information to the large number who are constantly demanding it is evidently a work of no mean proportions, and it must necessarily embrace departments of so varied a character that no one person will be able to write authoritatively on all the subjects connected with practical electrical engineering problems of the day. The electrical enginner at the present time is called upon as often to solve questions of mechanical and steam engineering as he is those of an electrical nature, and hence a work to be of use must include all these other branches within its scope. To fulfill this object there has recently appeared the work entitled as above, of which four parts now lie before us.

The eminence of the contributors would at the outset appear to be guarantee of its value, and a closer examination of the parts which have thus far appeared yields unmistakable indications of the value of the work. The idea which the authors have set before them, is to furnish the reader with a record of the best results of ripe experience, rather than the history of the experiments which have led up to them. For all that, however, a thorough exposé of the subject must include the principles upon which established facts are grounded, and hence it is eminently proper that the work opens with a chapter on the general engineering principles of electricity, in which the two circuits, the inductive and the magnetic, are taken up and thoroughly discussed, and the main laws upon which many calculations depend clearly set forth. The various phenomena connected with the wire carrying a current, including magnetic, heating and others most generally involved in electrical engineering apparatus, are very fully treated, and numerous tables giving the results of practical experiments are added, among them being the most recent ones of Mr. Preece and Prof. Forbes. The chemical action of the current is also given due consideration.

Next in order we find the phenomena connected with the exterior of a conductor carrying current, and with the magnetic circuit, taken up; and the interactions between a conductor carrying a current and one with no current, and two conductors both carrying currents, are discussed. A short but concise chapter on the inductive circuit, in which the relation of charged bodies to one another and their specific inductive capacity is treated furnishes what may be called the exposé of the principles; and we may remark here that, throughout, the subject is presented in an entirely original manner, differing widely from that met with in the usual text books. In some respects its dicta and dogmas vary from the popular notions now prevailing, but it is none the less clear, and to the extent of its novelty is all the more interesting.

The leading notion here employed in the explanation of the phenomena treated has been to consider that current is due to a difference of electrical pressure, and this idea will be carried out, and we believe with advantage, in the subsequent parts of the work, when the description of machines will be gone into.

In chapter V what is called Electro-graphics is taken up, which will give the student an excellent idea of the manner of representing graphically the action met with, and the results obtained in electrical tests. This is an important consideration, as to many, a table of values is not nearly so eloquent as a curve representing the action going on, as, for instance, in the construction and calculation of dynamo-electric machines.

Chapter VI takes up the central station and treats of the installation of all the parts which go to make up this important element in the distribution of electricity. After a preliminary discussion of the economic problems and conditions to be met with in the situation of a station, the manner of its construction is gone into in a very thorough manner, beginning with its foundations and passing through the entire construction. In the part before us the information on the nature of the soils and methods of building is briefly but concisely sketched and present indeed a very good resumé of this part of the subject. Part III continues the central station work, and taking up the subject of steam boilers describes very fully the construction of a variety of boilers, the designing of chimneys and the numerous details which pertain to this part of the plant. Some attention is also given to the design of boilers, the strength of the parts, etc., and the relative advantages of various methods of construction.

Part X, which has been issued in advance of the intermediate numbers, and very wisely so, takes up the subject of dynamos, alternators and transformers. Though only the mere beginning of what is to come, the contents of these forty-two pages give sufficient proof that the reader will be entertained with a literary treat on a subject as to which the demand for information is enormous, but upon which, unfortunately, but a comparatively small amount of matter is available, or rather digestible, by the majority of readers. Mr. Kapp presents in a clear manner the conditions involved in the construction of such machines, beginning with the general scope of the theory of dynamo-electric machines and passing in succession through the magnetic field, the calculation of its strength, and measurement, and he accompanies the various discussions by numerous practical examples which have unhappily been lacking in many otherwise good discussions of the subject, but which are here introduced with excellent effect and will be welcomed by many readers. This part of the work is not entirely free from formulas, nor could it be otherwise, as the subject is one which for a thorough treatment must introduce calculations of a higher order than simple arithmetic; but for all that they are of such a nature that they can be readily handled, and, indeed, the more important ones are quite simple. Here are also discussed the magnetic properties of iron, and the relations which they bear in the construction of dynamo-electric machines. The loss met with in the magnetization of iron is also taken up and the author gradually leads up to the electromotive force generated in the armature conductor on its passage through the field of a given strength and with a given velocity.

While the contents of the parts before us are exceedingly accurate in the light of the most modern research, there are one or two points which we think require notice. Thus on page 8, Prof. Matthiessen's table of conductivity of the metals is very properly given as a standard. On page 11 we find this same table referred to and expressed in a different form, but showing the conductivity of copper to be greater than that of silver, and the relative values of the other metals are also different from those of the Matthiessen table. It is evident that the second table has been constructed from data embodied in the results of the latest investigations, such as those of Benoit. It would have been well to have pointed out this discrepancy in order to avoid possible misconception on the part of the reader. In the discussion of power and work we notice an error on page 14, in which a horse power is given as equal to 42.75 thermal units. This confusing of power, that is, the *rate* of doing work, with thermal units which represent actual work or energy, seems to us to require pointing out and correction. In a subsequent part of the work, page 10, of Part X, in referring to the same question, the proper definition is given, though in a somewhat different form. In a work like this, however, slips of this sort will, of course, come in, but they do not affect the accuracy of the work as a whole and are merely pointed out for possible future revision.

The book throughout is clearly illustrated and printed in large, clear type. We shall await with pleasure the issuance of the succeeding parts of this noble work, which seems destined to place in the hands of the student and engineer what many have been looking forward to with anxiety and hope for a long time past.

JOSEPH WETZLER.

LOVE, RYAN & BURNETT.

A new law firm just formed in this city with offices in the Potter Building, Park Row, is likely to have the best wishes and cordial interest of the electrical fraternity. It is that of Love, Ryan & Burnett. Mr. H. Warren Love is a graduate of the Albany Law School and a practitioner of many years experience. Mr. James G. Burnett is a graduate of the Law School of the National University at Washington, and in his early days was a newspaper man. Under his supervision was constructed a telegraph line from the *New York Herald* office to Whitestone, L. I., and it is believed that this was the first line ever built and owned by a newspaper. Of Mr. R. W. Ryan, the other member of the firm, it is needless to say very much to electrical engineers. He is a graduate of the New York University Law School, but has only of late taken up the active practice of his profession. Being perhaps the best technical stenographer in this city, his services have been in unceasing demand for this very difficult class of work. and hence he has hardly ever had a moment to think of anything else. Not only has he been retained by nearly all the engineering bodies in New York, but he has been particularly popular with electrical men, so that he has reported the proceedings for years past of the National Electric Light Association, the American Institute of Electrical Engineers, the New York Electric Club, the National Telephone Exchange Association, and others. This peculiarily new and difficult work has been done with marvelous accuracy and the greatest intelligence. Latterly Mr. Ryan has been acting as private secretary to Police Commissioner McLean, a distinguished lawyer, and he thus arrives at the goal of a worthy ambition.

EUROPEAN CORRESPONDENCE.

LONDON.

Electric Traction in Leeds.—Electric Lighting of Small Towns.—Electric Light in Churches.—Electric Light in Madrid.—Telephones and Churches.—French vs. English Steel.—Fire Risk Rules.—London Central Station.—French Elmore Company.—Electric Car Accident.

I MENTIONED in my last letter that it was probable electric cars would be adopted on a section of line in Leeds. The proposal has now taken a more definite form. The Thomson-Houston Company, through their English agents, have offered to place six cars on the line as soon as possible. They undertake to pay the Corporation the nominal rental of 100 guineas on the understanding that the local authority erect sheds for the cars, offices, and other necessary buildings. At the end of two years, if the Corporation decide to use electricity on the other lines in the town, the rolling stock of the American company will be sold to them at a fixed valuation. This matter has to be finally settled by the Highways Committee and the County Council; if these bodies approve, the cars will be in working order by the end of the year.

Another town to be wholly lighted by electricity is a small place named Fareham, in the county of Hampshire. It is a somewhat remarkable thing that the smaller towns have shown, in regard to electric lighting, much more progress than the larger places.

Chelmsford, one of the earliest to adopt electric lighting publicly, is a comparatively small place. Fareham is an old-fashioned English country town, blending ancient rusticity and modern trade. The lighting is carried out by the Fareham Electric Light Company, a concern supported entirely by local capital. To comply with Board of Trade regulations the wires are carried on tall poles. The two chief streets with a united length of about a mile are lighted by 21 arc lamps of 1,200 candle power each, Thomson-Houston system. The smaller streets are lighted by 20 candle-power incandescent lamps, one lamp being placed where previously stood a gas lamp. Messrs. Laing, Wharton & Down, agents for Thomson-Houston, are responsible for the work. The company has entered into an engagement with the town authorities to light the town for three years for £500 per annum, to give an average of eight hours light every night all the year round. A curious feature in connection with the lighting is to see the parties arrive at night fall from the surrounding villages, who stand in little groups about the quiet streets and gaze for a considerable period at the lamps.

Church lighting by electricity is becoming fashionable, and the latest addition to light in dark places is St. John the Divine, Brixton. The plant supplies 300 incandescent lamps. A motor is also used for blowing the organ.

The Electricity Supply Co. of Spain, an English Company acting under a concession from the local authorities, has just completed a central station in Madrid, and houses are being lighted at a distance of two miles from the works.

The telephone company in Birmingham is arranging a system by which subscribers will be connected with the church presided over by a popular preacher, and will be enabled to hear the sermon with distinctness.

In my former letter it was said that Mr. Preece had found French steel much superior to English. An English firm now say that they supplied the very specimens characterized as French to M. Marchal, and have supplied him for many years past. This certainly replaces the feather in the cap of English manufacturers.

The Fire Risk Rules have been the subject for correspondence in the columns of the *Times*, which has lasted a considerable period. Prof. Silvanus Thompson and many others have taken part in a wordy warfare. The rules laid down by the Institution of Electrical Engineers and adopted by some companies have caused considerable dissatisfaction to many. Others on the contrary hold that the rules are practically safe. No matter what may be the outcome of this, few fires have been caused in London by the use of electric light.

It is stated that the Manchester Square station of the Metropolitan Company is near completion, and at present they are running one 100-unit dynamo night and day. It is probable that I shall have more to say about this later on.

The French Elmore Copper Co. has been formed to work the patents of Messrs. Elmore in France, with a capital of £200,000 in £2 shares. 66,750 shares were offered to the public at a premium of 10 s. per share. I hear on very good authority that there were three times as many applications for shares as could be supplied.

A newspaper correspondent telegraphed from Florence yesterday the news of a fatal accident which occurred on the electric tramway between that place and Fiesole. The cars ran off the track, five persons being killed on the spot and twenty others injured.

H. S.

LONDON, Sept. 24, 1890.

CORRESPONDENCE.

CHICAGO.

A Brotherhood of Telegraphers Movement.

A MEETING of railroad and commercial telegraph operators was held last week at Orpheus Hall, on La Salle street, for the purpose of effecting an affiliation between the commercial operators and the railroad operators, and was called by the Brotherhood of Telegraphers.

The organizer, Mr. A. L. Morris, explained that the Brotherhood had at the present time nine active lodges and nine others in the course of organization. In an address he said that the difficulty telegraphers were laboring under at present was want of organization between the commercial and the railroad men, and that when any trouble arose with the commercial men railroad operators could be obtained by the Western Union or Postal from the railroads, and vice versa. If the men would only organize and bring about an amalgamation of the two bodies they could maintain the rate of wages, and instead of first-class men earning $65 per month they could demand the standard pay of $80 or $90. He thought the organization of both bodies of men in one brotherhood would deter rather than promote a strike, as the mere fact of such a brotherhood existing would prevent the cutting down of wages.

Before the meeting adjourned a number of commercial and railroad operators joined the new organization. About sixty-five operators were present.

CHICAGO, Oct. 4, 1890.

BOSTON.

Lighting the Shoe and Leather Exchange.—The Boston Electric Elevated Road.

THE petition heard before the gas commissioners, Tuesday, wherein the Shoe and Leather Exchange ask that the Edison company be obliged to furnish electric lights for their building is complicated by the fact that the building has its own dynamos, and the Edison company's electricity is wanted only after the building's dynamos have stopped. The dynamo is run from about 2 o'clock to 6, and a few tenants need light later. The Exchange was represented by H. W. Chaplin and the Edison company by W. W. Gooch; Messrs. Claflin & Kimball, agents of the Mather electric system, were present in the interest of the Exchange, as they furnished the dynamos and did the wiring in the building. The Edison company claimed that the system in use in the Exchange was not suitable for the working of their plant, while the Exchange put in evidence to show that it could be operated with ease.

President Whitney, of the West End Street Railway Company, has at last unfolded his scheme for an elevated railroad in this city, and a conference between representatives of the West End Company, Mayor Hart, Corporation Counsel Richardson, and the members of the railroad committee of the Board of Aldermen was held at the West End Company's office on Wednesday. The scheme provides for a double track 4.90 miles long, extending from Roxbury post office *via* Washington street to East Dedham street, thence to Harrison avenue and Hawley street, thence *via* Water street to Devonshire street, thence to Haymarket square *via* Adams square and New Washington street, thence to Charlestown, and from thence to Charlestown Neck, the northern terminus, with a loop touching the northern depots. This route necessitates the formation of a new street from Harrison avenue to Hawley street, and also from Hawley street to Water street, the value of the property which will have to be torn down being probably about $2,500,000, though it is not yet decided whether the railway company will have to bear the whole expense.

The site of the Roxbury station has not yet been decided upon, but it will be in close proximity to the post office on Warren street. The Charlestown Neck station will be near the West End car stable there, on land now owned by the company.

The style of elevated structure to be used has not yet been decided upon. President Whitney, Vice-president Reardon, General Manager Monks and Electrical Engineer Pierson have been making extensive researches in this connection, and have examined about every elevated road system that has been invented. One conclusion they have reached is that their roadway shall not be like that of any yet built, but shall contain all the good features of such as they have seen, and some points entirely original.

They have engaged as chief engineer, Thomas C. Clarke, and he is now at work on plans. Mr. Clarke is one of the most noted engineers in the country. He had charge of the Gilbert elevated road in New York, designed the Poughkeepsie bridge and several others in this country and abroad, and was consulting engineer on the Brooklyn bridge.

All the details as to motive power have not yet been settled, and experiments are constantly being made at the works of the

company on Albany street. One thing is certain, and that is that electricity will be used, so that there can be no ground for objection to the road on account of smoke and cinders. The power will be applied to the motors by means of feed wires, as is the case with the present surface road system, but instead of being strung overhead they will be laid along the structure at, or a little below, the level of the tracks, and the current will be supplied through connections under the motors.

The opinion seems to be generally favorable to the scheme, though in event of its rejection another route may be laid out which would not necessitate the destruction of property, but which would introduce a number of dangerous curves. The new streets would be a boon to the city anyhow, as they would serve to relieve Washington street of much of its heavy traffic.

BOSTON, Mass., Oct. 4, 1890.

PITTSBURGH.

A New Electric Forging Machine.—An Electrical Oil Well Driller.—Electric Railway Work.—Municipal Electric Service.

ELECTRICITY is about to be introduced in the iron mills of Carnegie, Phipps & Company, in this city, in the manufacture of iron and steel. Two prominent officials of that firm recently received a patent for an electrical device, called an electric-forging machine, which is used for the purpose of "stoving" eye-bolts for bridge structures. The machine so far has only been used on an experimental basis, but as these experiments have been very successful, it will be generally introduced in the works very shortly. The inventors claim that by the use of this machine a greater amount of work can be performed, and there will also be a great economy in time and expense, as fuel will only be needed to furnish power for the dynamos.

Another Western Pennsylvanian is also deserving of great credit for inventing an electrical machine to be utilized in the drilling of oil wells. The apparatus is a unique affair, and if a success, the business of drilling oil wells will be entirely different to what it has been heretofore. It is a well-known fact that at present a great many heavy tools, necessary in drilling oil wells, are very cumbersome to handle. This new device, however, is to do away with them. It is an apparatus composed of a series of small motors arranged behind each other. This appliance is let down into the well and drills the hole. The rod and drill bits are projecting from the series of motors and the combined force of all acts upon the rod and the bits. Several tests have been made with the machine and all are said to have proved the apparatus to be a great success. The inventor claims that his machine will not only be a more effective driller than the appliances now used, but it will also be labor saving.

The Verner Street Electric Railway Company has been organized under a charter received a few days ago from Harrisburg. Work on the road will soon be commenced. When completed, the line is to be combined in the Pittsburgh and Manchester Electric Railroad system.

All the machinery for the new electric fire alarm office in this city will soon be in position, and Mr. Morris Mead, the superintendent of the Pittsburgh bureau of electricity, says that he will have the most complete fire alarm in this country.

In the city of Allegheny, where an electric light plant is now operated by the municipal authorities, an increase of the number of lights is soon to take place. The plant has now 3,000 incandescent and 450 arc lights, Westinghouse alternating current system, and the city intends to put up one hundred additional arc lamps.

PITTSBURGH, October 3, 1890.

ELECTRIC LIGHTING IN WASHINGTON STATE.

Mr. A. C. Balch, of the Pacific Electric Light Co., of Seattle, Wash., writes us : "In THE ELECTRICAL ENGINEER of August 20, I find an article on Central Station Statistics of the United States, in which the statement is made that in Washington there are central stations using 250 arc lights. This does not give Washington credit for quite as many as are being burned, as Tacoma has some 600, and Seattle, over 750. Port Townsend, Spokane Falls, and Walla Walla, each have quite a number, besides a great many smaller plants in other towns with from 30 to 50 each." It will be remembered that with regard to the statistics, which were not our own, we said that they would be found conservative and under the reality. Mr. Balch's interesting data shows that this is particularly true of so rapidly progressive a State as Washington.

Of the numerous forms of lamp guards now in use, many need a shade-holder, and others have so coarse a mesh as to afford but little protection. Seeing this, Mr. George Cutter has brought out a new form of expanding wire-guard which combines the good features of all the others. It has five rings surrounding the part of the bulb which most needs the protection, has sliding sleeves which adapt it to any 16 candle-power lamp, and looks much neater than the older forms. The Great Western Electric Supply Co. are pushing this guard.

REPORTS OF COMPANIES.

NORTHWESTERN TELEPHONE EXCHANGE CO.

The Northwestern Telephone Exchange Company (Erie company) has elected the following officers : President, Levi Sprague ; secretary and treasurer, Charles J. Glidden ; directors, Levi Sprague, Charles J. Glidden, A. S. Adams, C. E. Adams, W. A. Gove, J. E. Hudson, Francis Jewett, J. W. C. Pickering, A. C. Russell, Thomas Sherwin, James A. Weston and H. A. Whiting.

INTERNATIONAL PORTELECTRIC CO.

The annual meeting of the stockholders of this company will be held at its office, 254 Pearl street, Wednesday, October 8th, 1890, at 2 p. m., for the election of Trustees for the ensuing year, and any other business that may regularly be brought before the meeting. The Transfer Books will be closed at 3 p. m., October 4th, and reopened on the morning of October 9th, following.

CLEVELAND TELEPHONE CO.

The Cleveland Telephone Co. has chosen the following officers: —President, Levi Sprague ; vice-president, J. P. McKinstry ; secretary and treasurer, C. J. Glidden ; directors, Levi Sprague, J. P. McKinstry, Charles J. Glidden, C. E. Adams, J. E. Hudson, A. B. Hough, W. J. McKinnie, T. Sherwin, G. W. Short, E. P. Wright, E. P. Williams ; executive committee, Levi Sprague, Charles J. Glidden, A. S. Adams, C. E. Adams, J. E. Hudson, W. A. Gove, Francis Jewett, J. W. C. Pickering, A. C. Russell, Thomas Sherwin, James A. Weston, H. A. Whiting.

HEAVY DEALINGS IN THOMSON-HOUSTON STOCK.

At a meeting on Saturday, Sept. 27, the Thomson-Houston board of directors voted to sell Messrs. Lee, Higginson & Co. 50,000 shares of common stock at $50 per share (less a bankers' commision, presumably), and they have now voted to sell shareholders of Oct. 8, 10,000 shares of common stock at $50, payable on or before Oct. 15, and chose T. Jefferson Coolidge, Jr., president of the Old Colony Trust Company, a director of the Thomson-Houston Company. It is understood that President S. Endicott Peabody, of the American Loan & Trust Company, will also enter the Thomson-Houston board. The 50,000 shares of stock are payable Oct. 1. Speaking of this, the Boston *Herald* says : "These sales will yield the company $3,000,000, less any bankers' commission, an amount sufficient to clear off every note payable, and leave a working balance in cash. The addition of the names of Messrs. Coolidge and Peabody will introduce a strong Boston financial element to the board, and the sale through the banking house will increase the strong and wealthy element in the list of stockholders. The Thomson-Houston company has been a sort of Lynn institution, with a certain wealthy backing in Boston and New York. The large sale of preferred stock was to a considerable extent made abroad. The new issue of common goes chiefly to investors, and it compliments the bankers that they have placed this stock in a pinching money market, which they could do through their own endorsement and the exhibit which the company was able to make privately, an exhibit heretofore outlined in a general way in this column. The bankers not only bought 50,000 shares of common stock, for which they already had a market, but could place 6,000 to 7,000 more, which, perhaps, assures the taking of the 10,000 shares, if stockholders do not want them. The company still has 60,000 shares of common stock in the treasury, whose sale is authorized by vote of shareholders. It does not appear that the company has any need to sell this balance, and it would possibly help the market for outstanding shares if a resolution not to sell these shares within a stated period should be passed by the directors. The present sale in private helps the stock by cancelling the debt and by bringing strong support to the company. How much of the proceeds of the 50,000 shares, $2,500,000, payable Oct. 1, remains in Boston, and how much of it comes from Boston, is not known. The company still owes $300,000 on account of the Brush purchase, payable in equal installments in October, November and December, or all may be paid in advance. That money may go out of town, and then some notes payable are believed to be held by out of town institutions. It is quite possible that this transaction may be a factor in the money market. The Thomson-Houston Company receives, say, $3,000,000 for common stock, say, $2,500,000 for preferred stock and $1,000,000 on account of collateral trust bonds—say, $6,500,000 in all, a pretty good indication that its maturing obligations were in the vicinity of $6,000,000. The issued stock will soon stand at $6,000,000 common and $4,000,000 preferred, the latter requiring $280,000 for a year's dividend, and the latter $960,000, on the proposed basis of $4 per share, $1 quarterly. Together the dividends would call for $1,240,000 per annum, a figure far within present net earnings, as claimed."

FINANCIAL MARKET.

QUOTATIONS ON ELECTRICAL STOCKS.

Mr. F. Z. Maguire, Electrical Securities, of 18 Wall street, this city, reports the following quotations of October 4th from New York, Boston and Washington:—

NEW YORK.

	BID.		BID.
W. U. Tel. Co	81¼	Edison Gen. Elec. Co	94
American Tele. & Cable	83	Edison Gen. Co. Def'd	55
Centl. & So. Amer	155*	Consol'd Elec. Lt. Co	59
Mexican	205*	Edison Illn'g Co. N. Y	70
Com. Cable Co	...	U. S. Elec. Lt. Co	30
Postal Tel. Cable	89	North Am. Phonograph	....

*Ex. Dividend.

BOSTON.

	BID.		BID.
Thomson-Houston	50½	Ft. Wayne Co	11½
" Pref'd	26	Am. Bell	220
" Series C	11½	Erie	48
" " D	6	New England	51¼
" Int. Co	....	Mexican	.80 cts
Thomson Welding Co	200	Trop. American	..
Thomson Eu. Welding	77	Edison Phon'gph Doll	1¼

WASHINGTON.

	BID.		BID.
Penna. Telephone	25	U. S. Elec. Lt (Wash)	155
Ches. & Pot. Telephone	72	Eck.&Sold. Home Elec.Ry.	62
Amer. Graphophone	14½*	Georgetown & Tenallytown	58¼

*Ex-Dividend.

PITTSBURGH.

	BID.
Westinghouse Electric and Manufacturing Co	34

A TOWER OF LIGHT AT PORTLAND, ORE.

At the Exposition now being held at Portland, Ore., a tower, very similar in construction and appearance to the one which was called the "Tower of Light" at the Lenox Lyceum last spring, has been erected, and lighted with Edison miniature lamps. This is set in a large bank of flowers. The tower and festoons contain about 3,000 lamps of 4 c. p. each. The Edison Lamp Department have received a telegram from Portland, Ore., stating that the tower was completed in time to be lighted on the opening night and was a great success, giving entire satisfaction to the management and winning much applause from the public.

LEGAL NOTES.

LEGAL METHODS OF MAKING TELEPHONE CONNECTIONS.

The United States Circuit Court at Wheeling, W. Va., Sept. 11, held that a telephone company has the right to determine the manner and mode of making connections with subscribers, and there is nothing to prevent the companies changing from time to time these modes of connection with proper notice. The case was a suit for damages because the company insisted on subscribers calling for numbers and not for names.

A DECISION AGAINST W. U. POLES AND WIRES.

A decision made by Judge Stevens in the United States Court at Grand Rapids, Mich., on Oct. 2, is very important to the entire country, as it affects the right of the Western Union Telegraph Co., to use highways for their wires. Judge Severence rendered the opinion, and it was concurred in by Circuit Judge Jackson. It is the opinion of the court that the act of Congress permitting the Western Union to use all the Government Postal routes to string their wires, is permissive only, and does not give the company the right to go into the States and use the highways and byways unless by State authority, and that the occupancy and use of the streets must be under the regulations of the police powers vested in the several States.

The court further holds that the charter gives the city authorities power to regulate the use of the public highway, and that the city authorities can exclude the wires from any street, and can designate in which streets the company can erect poles and string wires. When the injunction was dissolved last week the city authorities promptly cut down the poles, and they are still down.

ELECTRIC RAILROADING AT BUFFALO, N. Y.

The Park electric system of the Buffalo Street Railroad Company has been doing some remarkable work this summer. Four cars are running on this branch, a distance of about one and three-quarter miles. The traffic on pleasant Sundays is extremely heavy, and each car is required to draw two trailers for a large portion of the day. Under these circumstances the following figures will be of interest:

July 16th, the road carried 17,000 passengers.
July 20th, " " " 8,000 "
July 27th, " " " 11,000 "
Aug. 3d, " " " 5,000 "
Aug. 10th, " " " 9,000 "
Aug. 17th, " " " 3,000 "
Aug. 25th, " " " 10,000 "

On August 3d the day was cold and disagreeable; on August 17th the weather was cold and rainy, which accounts for the small number of passengers carried.

This road is equipped upon the Edison system and has been in operation now for about fifteen months with remarkable results, the repair bills having been merely nominal, although the service called for has been excessive, particularly in the summer. The largest load ever carried was a little over twenty thousand, the occasion being a picnic, and the time being two days after the road commenced operation in July, 1889. But three motor cars were in service on that day, and this remains the greatest record ever made by that number of cars.

OBITUARY.—COL. A. D. BULLOCK.

Col. Anthony D. Bullock, of Cincinnati, president of the City and Suburban Telegraph Association and of the Bell Telephone Exchange, a prominent and wealthy capitalist and a highly esteemed citizen, died of apoplexy at his home in Mount Auburn, Friday evening, Oct. 3. He has two sons, one in Williamsrown, Mass., and one in Cincinnati. No man in Cincinnati was better known or more highly esteemed.

INVENTORS' RECORD.

Patents issued September 30.

Alarms and Signals:—*Electric Alarm*, A. Tschira, 437,369. *Fire-Alarm Signal-Box*, J. Young, 437,668.

Conductors, Conduits and Insulators:—*Machine for Covering Wire, Cord, etc.*, K. Vogel, 437,266. *Electric Cable*, D. Brooks, Jr., 437,330. *Conduit for Underground Wires*, T. M. Morton, 437,445. *Electric Conductor*, E. Clark, 437,568. *Insulated Wire*, C. F. Splitdorf, 437,632.

Distribution:—*Distribution and Regulation of Electric Currents*, F. Wilking and H. Müller, 437,272. *System of Electrical Distribution*, F. B. Rae, 437,512.

Dynamos and Motors:—*Electric-Motor Gearing*, F. J. Sprague, 437,259. *Dynamo-Electric Machine*, W. Hochausen, 437,360. *Electric Generator*, W. M. Mordey, 437,501. *Automatic Switch for Stationary Motors*, F. B. Rae, 437,662. *Armature for Dynamo-Electric Machines*, F. B. Rae, 437,663.

Galvanic and Thermo-Electric Batteries:—*Galvanic Battery*, E. H. Crosby, 437,393. *Galvanic Battery*, G. A. Liebig and C. Willms, 437,469.

Lamps and Appurtenances:—*Electric Illuminated Letter*, J. A. McEntee, 437,226. *Arc Lamp*, J. A. Mosher, 437,502. *Switch-Board for Electric-Lighting Systems*, R. F. Sawyer, 437,516.

Measurement:—*Electric Meter*, R. N. Dyer, 437,183.

Metal Working:—*Welding Metals Electrically*, C. L. Coffin, 437,570. *Process of Electrically Welding Metals*, C. L. Coffin, 437,571. *Electric Forging Apparatus*, G. Lander and J. H. Simpson, 437,654.

Miscellaneous:—*Method of Adjusting Watches*, G. S. Hunter and F. H. Corthell, 437,203 and 437,204. *Apparatus for Adjusting Watches*, G. S. Hunter and F. H. Corthell, 437,205 and 437,206. *Artificial Ground and Compound Metallic-Circuit System*, C. E. McElner, 437,311. *Electric Cut-Out*, E. E. Bailey, 437,324. *Electric Hand-Switch*, J. W. Battershall, 437,352. *Electric Snap-Switch*, W. Hochhausen, 437,359. *Electric Cut-Out*, W. J. Jenks, 437,362. *Lightning Arrester*, J. M. Kalbach, 437,363. *Magnet-Winding Machine*, J. J. Wood, 437,387. *Lightning Arrester for Fire-Alarm Boxes*, R. Hudie, 437,397. *Rheostat or Rheotome*, M. Deprez, 437,412. *Electrical Switch*, F. B. Rae, 437,513. *Electric Switch*, L. T. Stanley, 437,667.

Railways and Appliances:—*Electric Street-Car*, L. H. Leber, 437,210. *Electric Railway System*, C. K. Harding, 437,358. *Propelling Device for Electric Cars*, T. A. Edison, 437,428. *Support and Insulator for Suspended Conductors*, C. J. Van Depoele, 437,533. *Upward-Pressure Contact Device for Electric Railways*, C. J. Van Depoele, 437,534. *Motor Truck for Electric-Railway Cars*, C. J. Van Depoele, 437,535.

Telegraphs:—*Automatic Telegraphy*, D. Kuhnhardt, 437,307. *Telegraphy*, T. A. Edison, 437,422. *Telegraph-Key*, A. F. Purdy, 437,510.

Telephones and Apparatus:—*Coin-Operated Telephone Attachment*, H. F. Dugan, 437,293. Phonograph, T. A. Edison, 437,423, 437,424 and 437,426, *Phonograph-Recorder*, T. A. Edison, 437,425. *Method of Making Phonogram-Blanks*, T. A. Edison, 437,427. *Phonogram Blank*, T. A. Edison. 437,429. *Mechanical Telephone*, J. M. Russell, 437,694.

TRADE NOTES AND NOVELTIES

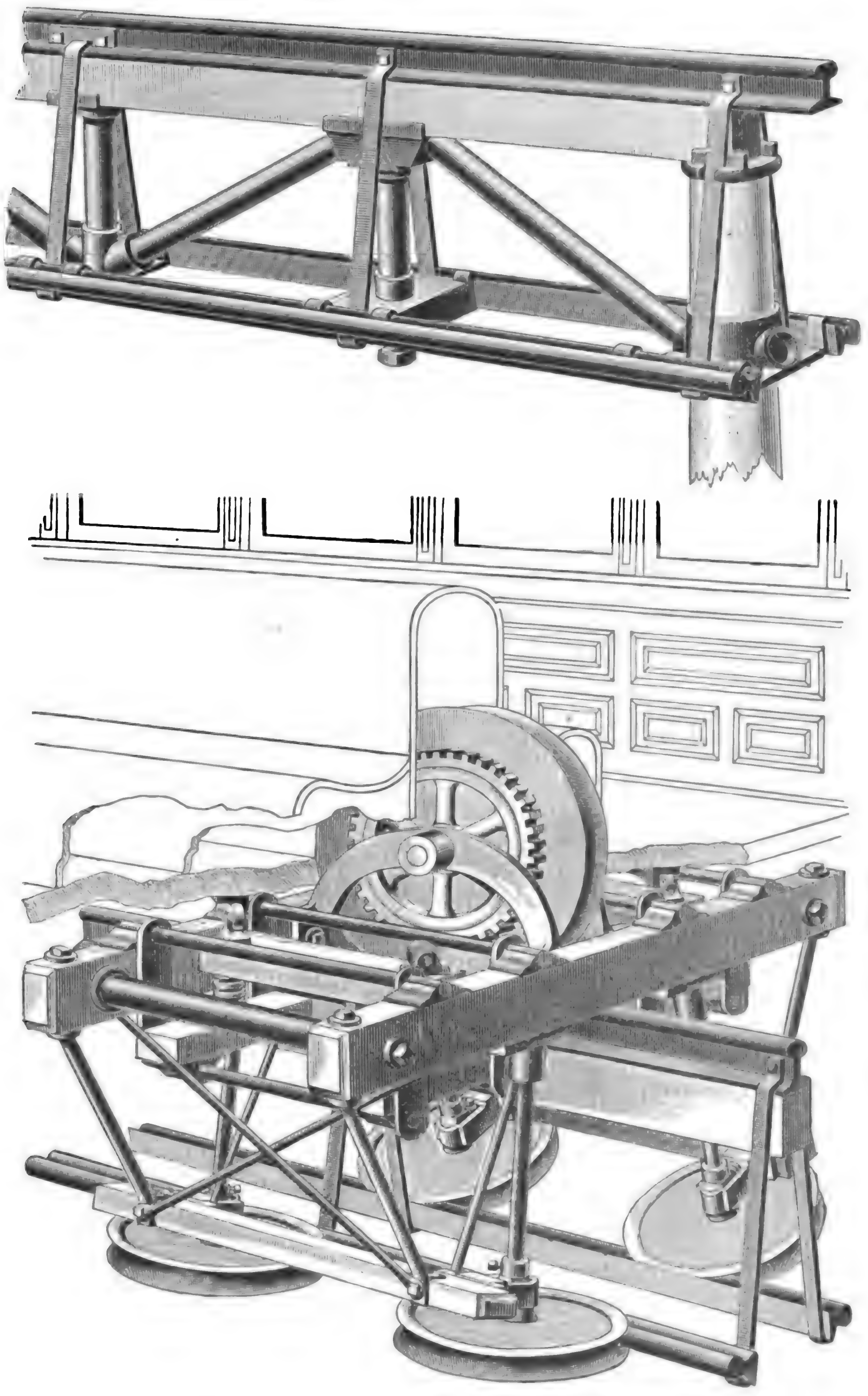
AND MECHANICAL DEPARTMENT.

THE UNICYCLE RAILWAY AT THE ST. LOUIS EXPOSITION.

The Turner system, which is known as the Unicycle Railroad, is shown in actual operation in the north end of the casement, at the St. Louis Electrical Exposition. A small Unicycle car, having a seating capacity for a motorman and two passengers, runs backward and forward on a single rail elevated track 120 feet in length. A 1 h. p. Sprague motor supplies the motive power. The system by its novelty attracts widespread interest, and hundreds of passengers are carried over it daily.

The inventor has sought to devise a simple elevated structure composed of few parts and easily constructed. Fig. 1 shows one section of a span. The main beam and rail are supported by posts which are well anchored into the earth. Side straps are bolted to the main rail, and, extending downward, have hooked ends which hold up the guide rails. Gauge pieces are placed between the guide rails, resting on the upper flange of same by two hooks on each side. These gauge pieces serve as rests for the lower ends of angle and upright braces. The centre gauge piece of each section serves as a nut for a tension screw for tightening up the section.

Fig. 2 shows a truck without the electric motor. The main double flange wheel runs on the main rail, revolving in bearings on two yokes from which are suspended the truck and car. The truck is provided with braces and beams which carry four small double flanged guide wheels. The guide wheels engage closely with the guide rails, and thereby keep the car upright, and also lock the truck firmly to the main rail.



FIGS 1 AND 2.—THE TURNER UNICYCLE RAILWAY.

The truck has a swivel motion. Anti-friction rollers play between the car bottom and truck frame working in a flanged ring on the bottom of the car, thus permitting the car to turn a short curve with ease and safety. The beams which carry the anti-friction rollers are mounted on springs, thus enabling the car to ride easily.

The electric motor is geared to the spur wheel on the main

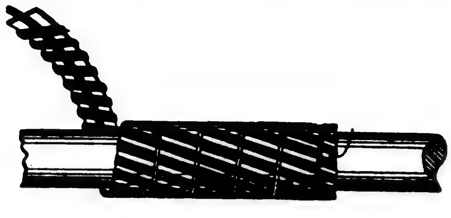
axle. The trolley wire is supported on one side of the main beam.

There is an automatic device not shown in the figure for equalizing the weight on the centre of the car and thus taking off all unnecessary friction.

The system is preferably constructed as a double-line road, the two sets of tracks running parallel. The two lines can be braced together, and thus made more substantial.

A NOVELTY IN INSULATION.

Mr. Charles F. Splitdorf, of this city, has recently patented an interesting novelty, in the line of insulated wire, by which high insulation and fire-proof qualities are obtained. This is effected by covering the conductor with thin and narrow strips of mica,



NEW SPLITDORF INSULATION.

first protecting and strengthening the mica strips by wrapping them round with silk, cotton, paper or other pliable and non-conducting material. The illustration herewith shows Mr. Splitdorf's method of insulation. The high insulating property of mica would indicate that wire covered by this new method would be very useful in cases of severe strain upon the insulation, such as is frequently met with in electric railway motors.

A NOVEL BILL OF FARE.

A report gained currency last week that the distinguished inventor of jokes and pleasantries, Bill Nye, had been secured by the new firm of Alexander, Barney & Chapin as an expert. While willing to believe anything evincing enterprise on the part of the new house, the electrical public thought that in this instance there must be a mistake. The appearance during the week of a highly original "menu," confirms the report, however, and Mr. Nye is to be congratulated on his venture as an electrical humorist. Surely none but he would have thought of blue vitriol for soup; turtle gong as an entrée; insulated joints under the head of roasts; automatic drops for dessert; and coffee in porous cups, with no grounds. We print the menu in full as a curiosity:

OYSTERS.

Neutral Points.

SOUPS.

Crowfoot Zinc.

Carbon.

Blue Vitriol.

FISH.

Pikes.

Poles.

Nippers.

ALEXITE—BEST VINTAGE.

ENTRÉES.

Monkey Wrench.

Pony Magnetos.

Turtle Gong.

ROASTS.

Joints, Insulated.

Spring Jack.

Buzzer.

EXTRA DRY BATTERY.

DESSERT.

Automatic Drops.

Cones.

Maple Balls.

COFFEE.

Porous Cups

(no grounds).

CIGARS.

Electric Club.

October 6, 1890.

This tempting menu was sent all over the country to friends and future patrons of the house, and Monday, 6th, saw the beginning of the influx, the store at 20 Cortlandt street being opened on that day for the first time for regular business. Lunch was served to three or four hundred visitors, among whom were the officials of all the leading electrical concerns in the city. There was also an excellent display of electrical supplies of all kinds.

ACTIVITY OF THE WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.

It is a fact, which experience in the electrical business has always manifested, that during the summer months, the industry is less active than during the remainder of the year. It is in the summer that the largest electric companies get an opportunity to catch up in filling those orders with which they are behind; or else they have a chance for working ahead and getting ready for the time when the heavy fall trade begins. Reports from all over the country show that this year is the greatest the electrical industry has ever known, and one of the largest companies is already so stocked with contracts for the equipment of electric lighting central station plants, for isolated plants, for electric railway equipment, etc., that the works are now being operated at their utmost capacity day and night, with every prospect of having to continue in that way for the entire winter. This company is the Westinghouse Electric and Manufacturing Company.

Since the company entered the field of constructing electric railway motors, especially, it has been obliged to increase its facilities very extensively. The many advantages of the company's railway motor have made it already familiar among most of the electric railway people in the country and the result is an influx of many contracts for street railway equipment.

The total amount of orders for alternating current incandescent lighting apparatus received during the month of September, aggregate 28,250 lights, which is over a thousand lights for each working day. Besides this, the demand for Westinghouse alternating current arc lighting apparatus has been unusually heavy and the company is far behind with its orders in that department. In the electrical railway department it is the same. The company has orders for the equipment of forty roads, calling for machinery valued at almost one million dollars and still the demand is increasing. The noiseless motor of the company on the Pleasant Valley Electric line, in Pittsburgh, continues to attract attention. To give an idea of the silent manner in which the motor operates it is only necessary to remark that the officers of the street car line have been requested by residents along the route to place a small bell on the axle of the car in order to make known to the people its approach and thus prevent accidents to children.

Among the new central station plants of alternating current lighting, the Westinghouse company has obtained contracts from Owensboro, Ind., 750 lights; Akron, O., 1500; Bedford, Ind., 750 lights; Norwalk, O., 1000 lights; Lykens, Pa., 750 lights; Penn Yan, N. Y., 750 lights.

In addition a number of the older central station plants have increased their capacity considerably. Among those having contracted with the company for an increase during the month of September are: Englewood, a suburb of Chicago, Ill., for 3000 lights; Bay City, Mich., 3000 lights; Duluth, Minn., 750 lights and Youngstown, O., 750 lights. It is remarkable in the latter case, that this plant in Youngstown is not yet in operation at all. After the company was organized, the management contracted with the Westinghouse Electric Co. for alternating current apparatus of a capacity of 2250 lights; but even before this machinery had been installed the management realized that the demand was greater than it had been at first anticipated and therefore this increase was ordered.

W. R. FLEMING & CO.

The firm of W. R. Fleming & Co., 174 Fulton St., this city, have been very busily engaged in the installation of numerous electric light plants. Representing the Ide and Ideal Engines, manufactured by the Foundry and Machine Dep't, H'b'g., Pa., and having consequently both centre and side crank engines of the same merit and make to present to purchasers, they have found some advantage, as their business record shows, over their past position in the sale of side crank engines only. Probably one of the showiest plants in New York city is being installed by them for running an Edison incandescent plant for the Hotel Marlborough, at 36th St. and Broadway. Two 80 h. p. self-oiling "Ideal" automatic engines will be the present engine equipment there.

Contracts have just been made for engines of this style for the following well-known concerns: Ferry-boat "New Brunswick," 40 h. p.; Fleischman & Co., New York, 30 h. p.; Browning, King & Co., New York, two 50 h. p. (6th order); Edison Ill. Co., New York, one 50 h. p.; Penn. R. R. Co., one 40 h. p.; Standard Oil Co., Jersey City, one 70 h. p.; C. H. Blanchard, New York, two 80 h. p.; Johns-Pratt Co., Hartford, Conn., one 70 h. p.

A number of large boiler plants have also been installed in the following towns: Providence, R. I., Martinsburg, W. Va., New York city, Fort. Worth, Texas, Cordele, Ga., and Montgomery, Ala.

SCHIEREN BELTINGS IN ELECTRICAL PLANTS.

About six months ago, Chas. A. Schieren & Co., of Ferry and Cliff streets, received an order from the Louisiana Electric Light Co., of New Orleans, for 160 feet, 72 inch, double leather belt, and 550 feet, 48 inch. This 72 inch belt, which is said to be the largest and heaviest leather belt in the world, has just been put on, and the firm have received a contract for a duplicate 72 inch belt. This will make two such huge belts in that single plant, besides about 600 feet of the 48 inch double. Chas. A. Schieren & Co., have lately extended their operations into the electric railway field, where they are already enjoying excellent success with their "Perforated" electric belting. The perforations prevent air cushions from forming under the belt, and hence the leather retains a firmer grip on the pulleys without slipping. The perforated belts will run with greater slack without slipping than any unperforated belt, consequently there is less strain on the bearings and the belts adapt themselves to the uneven strain of railway work, which is a peculiar strain, viz: the load is all thrown on at once, and all thrown off very suddenly. They have sold perforated electric belts to a great many electric railways, among which are the following: Utica, N. Y., Belt Line R. R. Co.; Seashore Electric Railway Co., Asbury Park, N. J.; Pennsylvania Motor Co., Easton, Pa.; Binghamton, N. Y., St. Railway Co.; Daft Electric Co., Philadelphia, Pa.; Omaha, Neb., Street Railway Co.; Edison Elec. Ill. Co., Brockton, Mass.; Edison Elec. Ill. Co., Newport, R. I.; Bangor, Me., Elec. Light & Power Co.; San Antonio, Tex., Street Railway Co.; Joliet, Ill., Street Railway Co.; Greenwood & Greenlawn R. R. Co., Columbus, O.; Naumkeag Street Railway Co., Salem, Mass.; Metropolitan Street Railway Co., Toronto, Ont.

The Belt.

Making the Belt.

A NEW DINING-ROOM PUSH.

It would seem that so simple a thing as a push-button leaves little room for improvement or change, but this is not wholly true. In the case of pushes used in connection with a wall or floor connection and a flexible cord, the extension part of the floor-push is now considered quite essential. Still the push button which is in use may be on the table, or on the lap of the hostess, or very likely on the floor, unless special pains are taken to look after it. But this is to be so no longer, for Mr. Chas. G. Armstrong has designed an attachment which holds the push in any desired place. It is evident from the cut that the new push

The Armstrong Dining-Room Push.

can readily be slipped on to the edge of the table, or on one of the side panels, or even on a chair. Whether the push is uppermost, or is concealed by being turned downward, it is always just where you put it. Any style of push-button can be furnished with this improvement, and the Great Western Electric Supply Co. will undoubtedly find a great demand for it.

NEW ENGLAND TRADE NOTES.

The Tripp Manufacturing Company, of Boston, will be represented at the Street Railway Convention, to be held at Buffalo, this month, and will have on exhibition a large model of their standard electric trucks, which are meeting with such favor with the street railway companies. The model will be equipped with the Tripp Anti-Friction Journal Bearings.

The Bryant Electric Company, of Bridgeport, Conn., have issued a neat little pamphlet, illustrating their specialties in switches, sockets, cut-outs, etc., with prices of same. These goods are having a large sale and the Bryant Company are already making arrangements to double their capacity.

E. S. Ritchie & Sons, of Brookline, Mass., have issued a complete catalogue of electrical testing instruments suitable for factory and laboratory use. The quality of these instruments, both in material and workmanship, is of a high standard, and are much more reasonable in price than those of foreign manufacture. Messrs. Ritchie & Sons supply the schools and colleges with these instruments, and are prepared also to build any special instruments which may be desired. A perusal of the catalogue will repay the reader, and they are useful to have at hand for reference at all times.

The Robinson Radial Car Company have received an order from the West End Street Railway Company, for 35 more horse cars, fitted with the Robinson Radial truck.

The Tropical American Telephone Company has secured the exclusive right to a new long distance telephone set, capable of transmitting 500 miles, for export purposes to the countries controlled by them.

The Thomson Electric Welding Company has leased three complete machines to Mr. Edison for use at his Schenectady works in welding copper wire from No. 20 to one-half inch. They will be delivered within 30 days, and are expected to make 3000 welds per day.

WESTERN TRADE NOTES.

The Sperry Electric Company are pushed to their utmost capacity filling orders for their arc light apparatus, and the demand for the new triple carbon arc lamp is increasing all the time.

J. Lang & Co., 44 Michigan street, Chicago, are very busy manufacturing the well known Lang & Andrews main line switches. They are largely used all over the country, especially for heavy currents, on account of their extreme simplicity and reliability. The new switches recently placed upon the market for alternating current work are also giving the greatest satisfaction.

Wm. Baragwanath & Son, 56 W. Division street, Chicago, have just completed a monster heater ordered a short while ago by the Chicago Edison Company, which weighs about 11 tons. Their shop is well filled with work on heaters of all sizes, and the large numbers which they have placed are spoken of in the highest terms of commendation by their users.

The Western Power Construction Company are meeting with the greatest success in building and equipping power plants. The McIntosh-Seymour engines, for which they are the exclusive Western agents, are giving the best of satisfaction wherever they have been installed, and are specially noticeable by reason of their noiseless running, regulation under variable loads, and high efficiency.

Mr. W. J. Floyd, who has recently joined the forces of the Sperry Electric Company as sales agent, is meeting with good success in pushing the apparatus of this well known company, and has already closed several large deals. Both the Sperry Company and Mr. Floyd are to be congratulated on the connection.

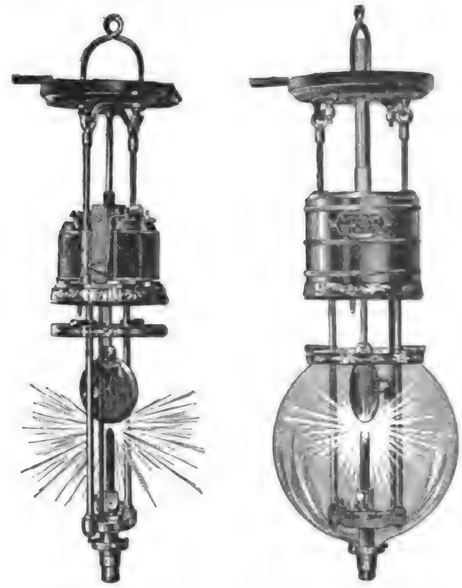
The Electrical Supply Co., 171 Randolph street, are as usual receiving orders from all parts of the country for their many specialties. They are continually adding new and valuable devices to their large line of supplies. They are doing a very large business in Habirshaw wire, for which they are the Western agents. The high insulating properties and toughness of this insulation are known from one end of the country to the other, and a vast quantity of it is in use in places where a high grade wire is called for.

The Pumpelly Storage Battery Company are making a large quantity of cells with their new method of sealing recently introduced by them. Their batteries are remarkable for the heavy discharge they will stand without buckling of the plates, and the general rough usage to which they can be subjected without injury or deterioration. The company are paying special attention to traction work, and manufacturing a very durable and compact cell specially adapted for this use.

THE RUSSELL ARC LAMP AT THE ST. LOUIS EXPOSITION.

THE Russell Electric Lamp Co., of 85 Water street, Boston, exhibit their 7 and 10 ampere arc lamps in operation. The new lamps attracts a great deal of attention among both electric light people and users of arc lights.

The novel feature of this lamp consists in substituting a carbon disc in place of the upper carbon rod. The upper carbon holder is controlled by a simple clutch device precisely as in the ordinary single carbon lamp. The carbon disc is attached to an axis by a very simple device and the axis is pressed into bearings in the ends of a yoke pin carried by the upper carbon holder. The axis carries a small pinion which engages with a rack. The rack is stationary and has no movement. By the movement of the upper carbon holder, the pinion—being engaged with the stationary rack—is caused to rotate and thus a rotary motion is



FIGS. 1 AND 2.—RUSSELL ARC LAMP.

given to the carbon disc. A fresh and unburned portion of the carbon disc is, therefore, steadily being brought into the arc. The disc of course has a slight vertical motion by reason of the feeding action of the clutch, but the rotary motion caused by the rack and pinion is the greatest and the one on which the perfection of regulation depends.

In the 10 ampere lamp the disc is about 4¼ inches in diameter, and the lower carbon, which is of the ordinary pencil form, is from 9 to 15 inches in length according to requirements. The 12 hour lamps are 33 inches in length and consume 9 inches of carbon, while the 24 hour lamps are 50 inches in length and consume 16 inches of carbon. Some of the advantages claimed for the lamp are that no light is wasted. The carbon disc being slightly thicker than the lower carbon, the rays are thrown out horizontally. There being less carbon resistance, less electric energy is required to produce a given light; and there is less cost for carbons per hour of lighting. Being shorter, it is specially suitable for inside use; and being of simple mechanical construction without complicated small parts, it is not liable to get out of order or to require delicate adjustment.

ORDERS FOR FITCHBURG ENGINES.

The Fitchburg Steam Engine Co. have recently received through their Philadelphia representative, Mr. G. H. Conner, Builders Exchange, the following orders:—Complete steam plant for the Suburban Electric Light Co., Tacony, Pa., for two 400 h. p. compound condensing slow speed engines, boilers, pumps &c. Also plant for the Powelton Electric Co., Philadelphia, for two 250 h. p. compound condensing slow speed engines, pumps, &c. Also one 250 h. p. engine for the Frog Moor Mills, Frankford, Pa. Also engine, &c., for Jacob Miller Sons & Co., Bordentown, N. J. Also two engines, boilers, bleach, &c., for the paper mill of T. S. Marshall & Son, Yorklyn, Del. They are also building a large compound condensing engine for the Quincy Market Cold Storage Co., Boston. Also for Clinton (Mass.) Electric Light Co.; Morgan Envelope Co., Springfield, Mass.; Farley Paper Co., Erving, Mass.; Boston Rubber Shoe Co.; Meriden Britannia Co., Meriden, Ct.; C. Parker Co., Meriden, Ct.; Crosby Steam Gauge Co., Boston. Also complete plant for a large brick company in Georgia. They are just starting engine for the Princeton (N. J.) Electric Light Co. They have also orders through their Chicago agents, Messrs. Kimball & Teal, 100 h. p. 80 h. p., and 75 h. p. engines for Chicago. Also 100 h. p. engine for Geneseo (Ill.) Electric Light Co., and are also building fourth engine for the large paper mill of P. H. Glatfelter, Spring Grove, Pa. This company have just completed a large plant for the U. S. Government at the Watervliet Arsenal, Troy, N. Y.

THE VAN NUIS "AJAX" SWITCHES.

Mr. C. S. Van Nuis, of 74 Cortlandt street, who has for some time past been devoting himself very successfully to the designing and manufacture of switches for heavy currents, will be present at the Buffalo Street Railway Convention with a full line of "Ajax" switches for street railway purposes. As is well known, the currents required in railway work are of heavy amperage, and Mr. Van Nuis has shown most creditable ingenuity in meeting the problems of the case.

THE RIVER AND RAIL STORAGE BATTERY.

The River and Rail Storage Battery Co. are about to issue a neat and tasteful catalogue of their storage batteries for various purposes, including medical use, phonograph work, domestic uses, etc. The company are receiving very flattering notices from those who have bought their batteries, and this new catalogue will serve to describe the merits of the cell to such as have not yet tried it.

THE "NATIONAL" SYSTEM AT JENKINTOWN, PA.

Mr. L. N. Cox, the agent of the National system at Washington, D. C., received recently the following letter from Mr. J. W. Ridpath, secretary of the Jenkintown, Pa., Light Co.: "We have a 1,000-light National machine running in a temporary plant, with a 25 h. p. engine, and furnishing 500 lights. With all the disadvantages under which we are laboring, the light is good, strong and steady."

THE WHITE "DAISY" RAIL CHAIRS.

Mr. R. T. White, the well-known inventor of the "Daisy" chair, etc., will be in attendance at the Buffalo convention next week with a model of his elevated railroad, cable road and conduit, "Daisy" chairs and girder rails, "Eureka" or channel iron form of street railway construction, and other novelties. This display of important novelties will prove very attractive.

THE WAINWRIGHT HEATERS, CONDENSERS, ETC.

The Wainwright Manufacturing Co., of Massachusetts, report a very large business for August and September in their improved corrugated tube feed water heaters, surface condenser and expansion joints. In these two months they sold 94 heaters and condensers, aggregating 11,095 h. p., and 44 large expansion joints, 8″, 12″, 14″, 16″, 18″ and 20″.

The following large concerns were among their customers for heaters, condensers and expansion joints, in the above period: Clinton Electric Light Co., Mass., 300 h. p.; New Bedford Gas Light Co., New Bedford, 700 h. p.; Fitchburg Steam Engine Co., Mass., 5 heaters, 800 h. p.; City of Easton Electric Light Department, Pa., 400 h. p.; Waltham Gas and Electric Light Co., Mass., 300 h. p.; Plymouth Electric Light Co., Mass., 250 h. p.

Many of the orders for heaters and condensers were made up in sizes from 20 h. p. to 150 h. p., inclusive, shipped to the following places: Mexico, South Carolina, Massachusetts, Maine, Connecticut, Illinois, Ohio, Pennsylvania, New Jersey, Minnesota, New York, Wisconsin, Long Island, West Virginia, Kentucky and Rhode Island. Among the orders for expansion joints were: West End Street Railway Co., Boston, 14, and Narragansett Electric Light Co., Providence, R. I., 2.

This company's business since their organization in 1889 has increased to a very great extent; and they now have the chief works in their line of goods in the country. They own exclusively all patents previously controlled by the Wainwright Manufacturing Co., besides many valuable patents granted since their organization.

The direct cause of their success is the great efficiency of their specialties, the prices of which are lower than for the ordinary manufactures.

Besides the above specialties this company does a good business in automatic gauge valves, corrugated copper baskets and Barnard's separators.

AN AUTOMATIC CUT-OUT CLOCK IN A BROADWAY STORE.

Jackson's mourning store people, No. 777 Broadway, are lighting their show windows with 10 incandescent lamps. The United States Electric Light Co. has put in an automatic clock and cut-out, which extinguishes the lights at midnight (or as soon before as necessary), thus saving the expense to the consumer of using the lights later than necessary and also saving the cost and trouble of a man to extinguish them at the desired hour. This is a case where the purchaser was looking for just such a device, before adopting electricity for illuminating purposes at night. The number of show windows throughout the country which are wired and fitted for electricity, but which are not used on account of the aforesaid expense, is very large. To such, the automatic clock and cut-out is a boon, as well as a profit to the electric light companies. W. H. Gordon & Co., 115 Broadway, N. Y., have taken the general agency for this automatic clock and cut-out.

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WORK ON THE WEST END STATION, THE LARGEST ELECTRIC POWER HOUSE IN THE WORLD.

BY A. C. SHAW.

IN view of the interest which naturally tends towards the application of electricity to street car propulsion, at this time, owing to the meeting of the Street Ra lway companies in Buffalo, I have thought there would be many persons glad to see the two engravings herewith showing the state of piling that was necessary must be borne in mind. Fig. 1 represents a view looking through the boiler house, and shows the style of the girder roof and the extent of the area required for the boilers. Fig. 2 is a view looking down on the foundation work for the large Corliss engines, and gives an excellent idea of the magnitude of the work. The foundation work is now all completed, about 8,000 piles having been driven, and about 35,000 tons of concrete and masonry used in its construction. The boiler house has been built for the full capacity of the steam power

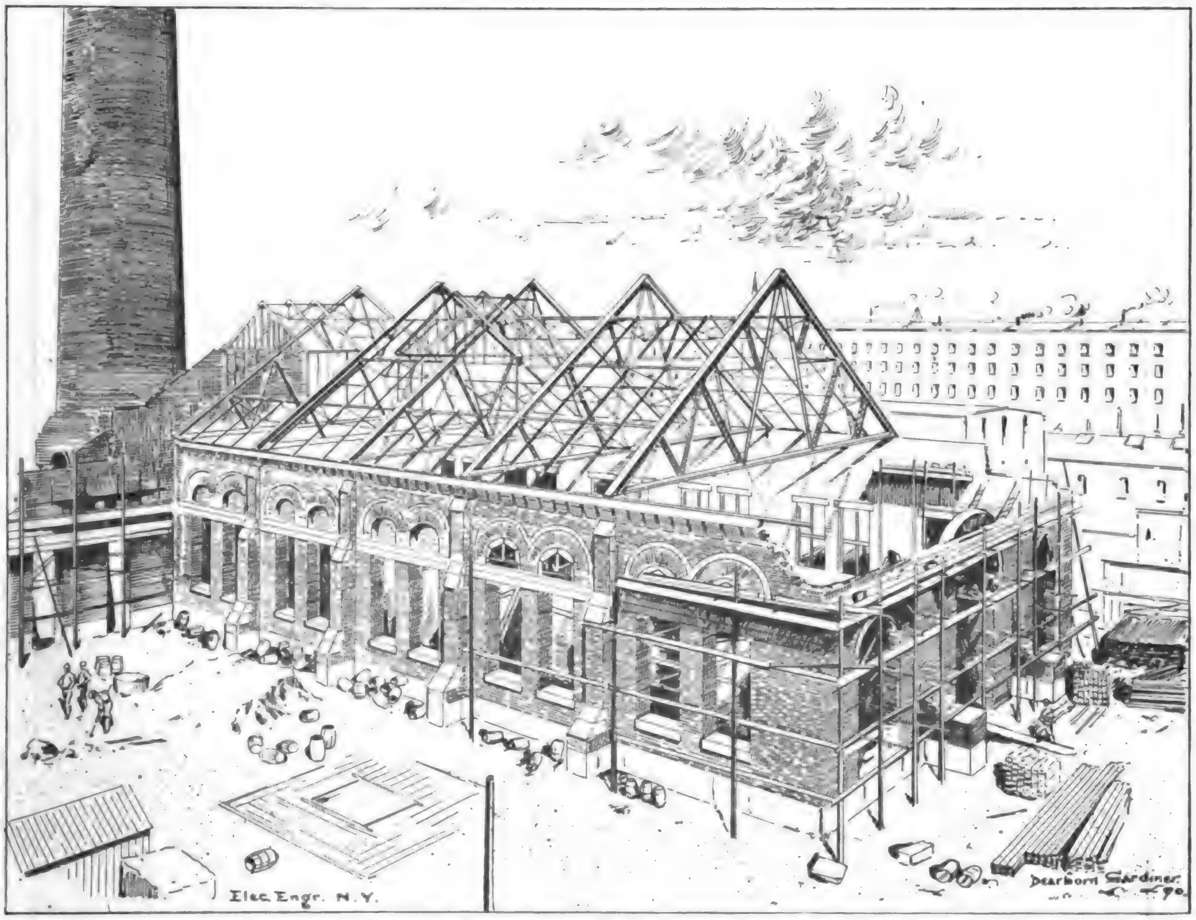


FIG. 1.—BOILER HOUSE, ELECTRIC POWER STATION, WEST END RAILWAY, BOSTON, MASS.

the buildings for the reception of the largest electric power plant in the world, in process of construction for the West End Street Railway Company, of Boston. The buildings are at present in a very unfinished condition, as shown by the engravings, yet so much interest is taken in the progress of this station, that I believe the pictures will attract some attention. The work on the foundations was begun about the first of October, 1889, so that one year has already elapsed, and, though apparently it is a long time, the nature of the ground and the immense amount of required, namely, 6,500 horse-power, though there will be steam enough for engine capacity of 13,000 horse-power. The dimensions of the house are 158 feet by 79 feet 6 inches, and six batteries of Babcock & Wilcox boilers of 500 horse-power each will be put in at present. The walls are of brick 33 feet high, and the girders of the double Fink truss type, built by the Boston Bridge Works, are all in position as shown. They are five in number, and have a span of 85 feet 10 inches. The chimney rests on a base 56 feet square, tapering to 30 feet at the top of the

foundation. It is now up 192 feet, measuring about 19 feet in diameter where it is now, and is 26 feet 8 inches in diameter at its base. It will ultimately have a height of 252 feet. Adjacent to the chimney and between the boiler house and the power house are the economizer rooms, pump room, toilet room and feeder rooms. The power house has foundations for six 1000 h. p. engines, now being built by E. P. Allis & Company, of Milwaukee, Wis., three being ranged on each side with the fly-wheels facing one another. The engine foundations are about 60 feet by 14 feet at the bottom, and 45 feet by 9 feet at the top. There is 12 feet of solid masonry, 9 feet of brick work, and a 20-inch stone slab on top for the engine to rest on.

The power house measures about 176 feet in width by about 150 feet long, and there will be a temporary wall built on the Harrison Avenue side, that is, the side furthest from the boiler house, as it is the ultimate intention to put in seven other similar engines, though the increase will probably not be made for two or three years. The engraving shows the Fink truss, of which there are three, for the roof of the central part of the power house, covering the countershafting and dynamo floor. The trusses for the roof over the engines will be similar in design, and will rest one side on the middle trusses, and the other on the walls of the building, which are not yet completed. The roof will probably be completed by December 1st, when

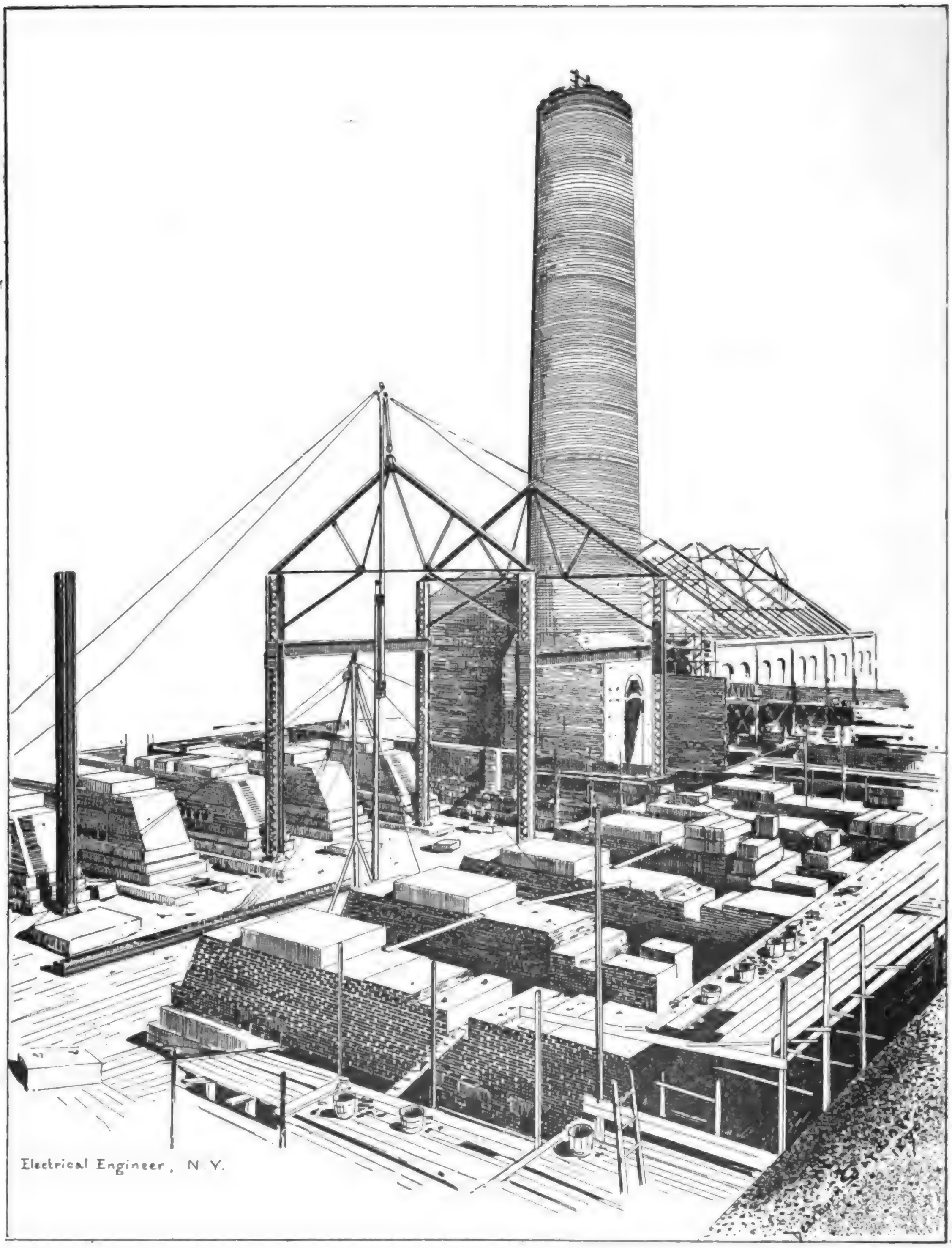


FIG. 2.—ENGINE AND DYNAMO HOUSE, ELECTRIC POWER STATION, WEST END RAILWAY, BOSTON, MASS.

the active setting of the engines and boilers will commence, and it is expected by May, 1891, to have some of the engines ready for work. The work is being rapidly carried on, and is attracting great attention on the part of visitors from all parts of the world.

THE RAE ELECTRIC RAILWAY SYSTEM.

As our readers may be aware, one of the first electric railways put into operation was the Highland Park Electric Railway, which was started in 1884, and is still in successful operation. This road was built by the Detroit Electrical Works, who some time ago put their railway and motor department in charge of Mr. Frank B. Rae, as electrical engineer, who has developed the system so that it represents to-day a whole, complete in every detail. As a complete description of the Rae system has not yet appeared, we present such an one to readers, from which it will be evident that Mr. Rea has struck out on a new line in more than one direction.

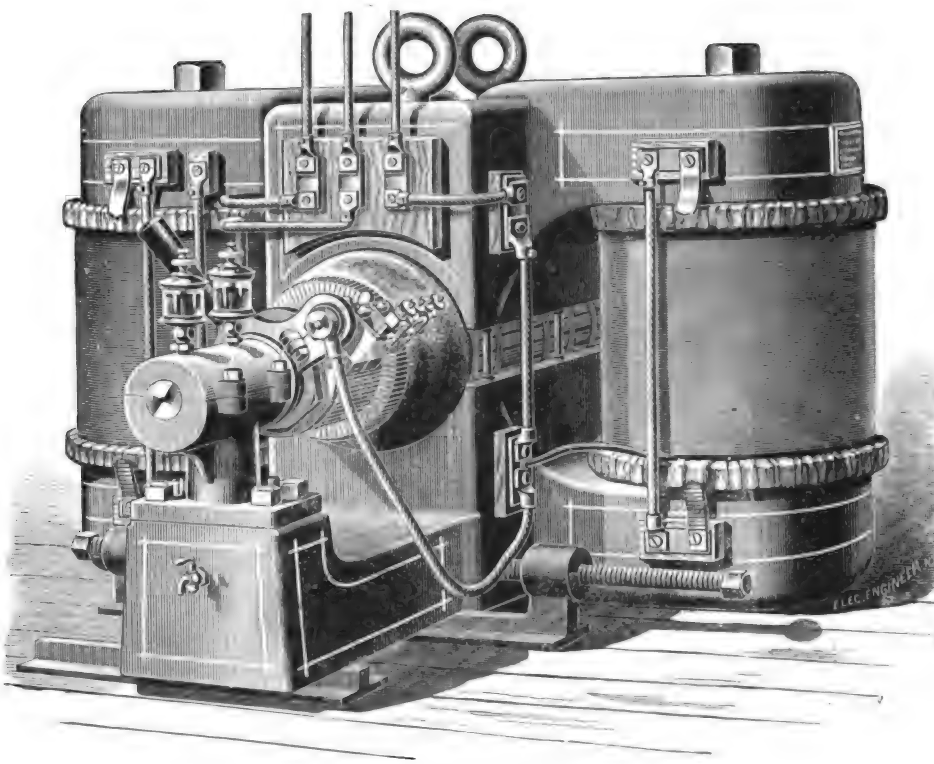


FIG. 1.—THE RAE RAILWAY POWER GENERATOR.

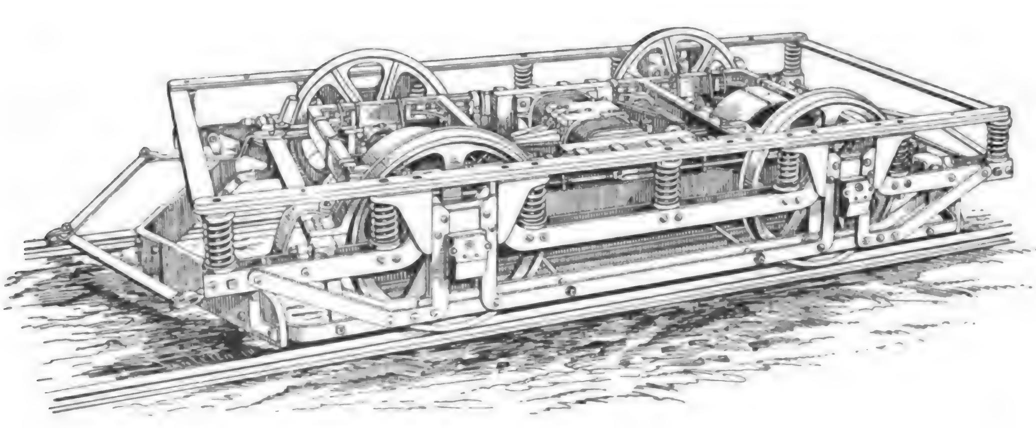


FIG. 2.—SINGLE MOTOR TRUCK, RAE ELECTRIC RAILWAY SYSTEM.

Beginning with the main source of power, the electric generator, we would call attention to a number of novel features entering into the construction of the Rae railway power generator. This machine, which is illustrated in the accompanying engraving, Fig. 1, is built in sizes of 40,000, 65,000, and 80,000 watts. The standard E. M. F. of 550 volts is maintained throughout the Rae system, and in order to avoid variation in potential on the line, with its consequent ill effects, the generators are compound wound. The field magnets, in order to obtain the highest magnetic effects, are made with wrought iron cores, and so that the magnetic strength may remain equal throughout the circuit, the cast iron employed for the yoke pieces is made of a section equivalent in magnetic capacity to that of the wrought iron.

Experiment has shown that the influence of the compound winding is enhanced by placing that winding as close to the armature as practicable. This has been carried out in the present instance by placing the winding on the cast iron yokes at the end of the cores. The compound winding, it will be noticed, consists of a flat ribbon of

copper, which is made equal in section to that of the armature conductors.

The Siemens armature, which is employed, is encircled by pole pieces, which are made equal in length to that of the armature by being extended at right angles to the main yoke pieces. The armature is built up of soft iron discs .007 inch in diameter, covered with shellaced tissue paper, and at every 20 discs a layer of shellaced cloth is interposed in order to thoroughly provide against the generation of Foucault currents. These discs are mounted on four brass splines, let into the shaft, and so arranged that an air space is left between the shaft and the inner diameter of the discs. By this construction it will be seen that no magnetic lines pass into the shaft, being prevented from doing so by the intervening air space ; and thus practically entirely avoiding leakage and straying of lines from the shaft and bearings. The commutators of all the machines have 80 sections, and the following are the electrical dimensions of the 65,000 watt machine : Armature wire, 1,000 feet of No. 4 B. & S., resistance, .061 ohm. Shunt winding, No. 17 B. & S., resistance, 250 ohms. The series coil, as above stated, has a carrying capacity equivalent to that of the armature, and consists of 60 turns complete, 15 in each coil.

Particular care has been taken with the connections of the machine, which are all permanently made before being sent from the works. These connections are all composed of copper bars, corded and covered with insulating paint, which is afterwards polished to resemble hard rubber. The shafts and bearings of the machine are extra heavy to withstand the sudden strains which are frequently experienced in railway work.

We come now to what is probably the most important element of an electric railway system, and that is, the motor and truck upon which it is mounted. Much has been said and written in the past on the method of gearing employed, and the relative advantages and disadvantages of each. In accordance with the tendency which seems to be gaining ground in more than one quarter among electric railway engineers, Mr. Rae employs but a single motor on his car, gearing it to both axles. The reduction of the source of power to a single machine brings with it advantages which cannot be denied ; involving, as it does, the equal distribution of power, irrespective of the load on the axles, and reduction in the number of gears and frictional surfaces, and the possibility of employing larger diameters of gears and pinions, with larger wearing surfaces. The general design of the Rae truck is shown in the accompanying engraving, Fig. 2, and Fig. 3 shows the same in plan. The motor has fields and poles of solid wrought iron forged, with the end yokes only of cast iron. From the sides of the pole pieces extend brass arms, which support the armature. A pinion at one end of the armature shaft gears directly with the gear of a counter shaft, which transmits the motion to both main axles by a bevel gear at each end. By this arrangement the speed of the motor does not exceed 900 revolutions at the full speed of the car.

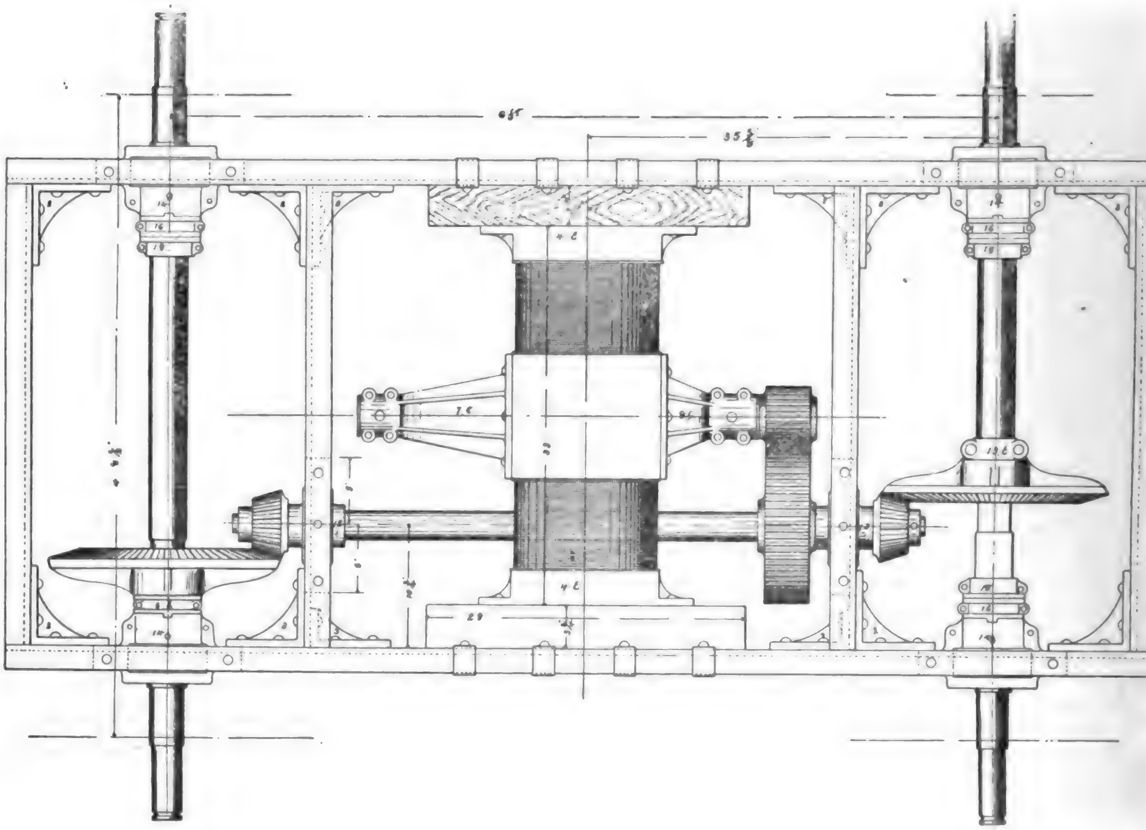


FIG. 3—PLAN VIEW OF TRUCK, RAE ELECTRIC RAILWAY SYSTEM.

The frame on which the motor and gears are mounted is made of channel iron bars with carefully leveled joints, planed square and true, put together with hot rivets, and finally tested for spring. The frame is absolutely rigid, in contradistinction to the usual practice of flexible construction of the motor support. To that end the axles are mounted in rigid bearings and side motion prevented by the use of graphite friction collars, which can be taken up when they wear. This avoids all back lash of the gear and consequent noise. The bevel gears are thoroughly encased in dust-proof boxes and run in oil. The motor is entirely insulated, being supported at the sides, as shown, by $2\frac{1}{2}$ inch oak pieces saturated in asphalt, and in addition by the raw hide or leatheroid pinions employed. The motor is of 30 h. p., and in the 16-foot car type a 6-foot wheel base is employed.

Special attention has been paid by Mr. Rae to the question of lubrication, and for that purpose all the bearings are bushed with graphite, doing away, practically, with oil,

and thus avoiding the dirt and other inconviences attendant on its use.

The motor employed on the car is series wound, and the means employed for its regulation by the motorman on the platform are exceedingly simple. The arrangement for that purpose is shown in the accompanying engraving, Fig. 4. The regulation of speed is effected by the interposition of four resistances through the medium of a very simple switch. These resistances are successively connected with the circuit in parallel, and finally short-circuited. The switch and rheostat containing these resistances is placed under the car, entirely out of the way, and on the platform of the car the single handle illustrated in Fig. 4 is placed. This is moved in one direction, or the other, for going ahead, or reversing. At the centre point a stop is provided, shown below the plate, to prevent accidental reversal of the motor by the motorman throwing the switch handle over beyond the middle point. By pulling out the stop, however, the handle can be reversed. The space occupied on the platform by this arrangement is very small and does not interfere with the occupancy of the platform by passengers.

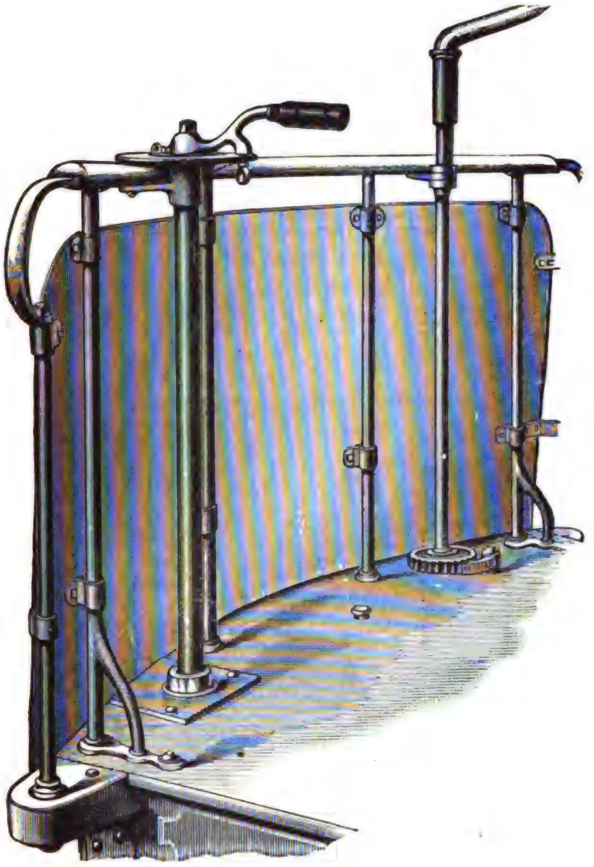


Fig. 4.—Switch-Handle on Platform.

A number of other details of this system relating to the overhead construction will also interest our readers. Among these are the trolley and trolley stand. These are illustrated in the engravings, Figs. 5 and 6. The trolley wheel, it will be noticed, is mounted upon a tubular steel pole, made in one piece, and drawn to three reductions, being ½ inch in diameter at the top and one inch at the bottom. This makes an exceedingly light and strong pole, and thus avoids considerable strain on the trolley stand mounted on the top of the car. The stand, shown in Fig. 6, is of special construction, and so designed that the tension on the springs is equalized throughout the range of motion of the pole. This is accomplished by an arrangement which changes the leverage between the spring and the stub end of the pole.

The trolley wheel itself, mounted on the top of the pole, has a bearing centre of phosphor bronze, the flanged sides which maintain the wheel in contact with the wire being of steel. In order to avoid oiling of the trolley wheel, graphite bearings are employed; the metal of the pole is also used as a conductor leading from the line wire to the motor.

Fig. 5.—Trolley Wheel and Pole.

Mr. Rae has also designed a special trolley line hanger and insulator. This consists of a bell-shaped, porcelain or lava insulator, Fig. 7, with a groove in its head, in which is inserted a brass clamp provided with yokes. A brass bolt is let through the insulator and secured by a nut at the top. This nut fits into a square socket, which is then filled up with insulating material. The clamp to which the line wire is attached is swiveled so as to give full play to the wire. These clamps are of brass. After being hooked on to the span wires the hooks are closed at the lower ends, which firmly secures the insulator in position.

In all Mr. Rae's overhead work the use of solder for connecting the various parts has been entirely avoided, as experience has shown that the heat required to sweat the parts together softens the copper, and when, later on, the slack is taken up, the copper draws at the point where the heat has been applied. To avoid this, therefore, screw clamps are employed throughout. Thus, as just pointed out in the case of the insulator, the wire is clamped to the swiveled suspension and the lower edges of the clamps brought down to a knife edge, so that the trolley passes under the insulator smoothly and without jumping.

This idea has also been carried out in the strain plates employed. These plates are put in at distances of about 1,000 feet, to take the strain off the line, and are also employed at curves, being so arranged as to pull the trolley wire towards the curve and thus to relieve the poles at the curve of all strain. The pull-off used by Mr. Rae embodies this same clamp feature. It is made of a wooden spindle saturated in paraffin and having brass ferrules at each end. The goose neck is made of steel and the whole is painted with insulating paint.

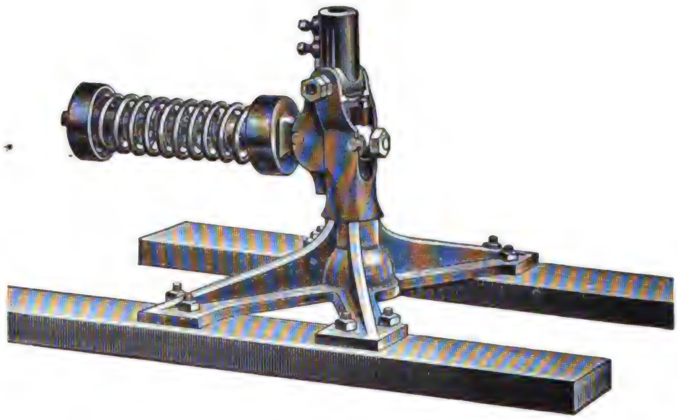


Fig. 6.—Trolley Stand on Top of Car.

Among the various station details employed in connection with the Rae system, space permits our drawing attention to only two; these are, the ammeter and the main switch. The former, which is shown in the engraving,

FIG. 7—TROLLEY LINE HANGER AND INSULATOR.

Fig. 8, is what is known as the Rae horn ammeter, taking its name from the shape of the iron core employed. The divisions are practically equidistant over the full range of the scale.

The compound station switch has three pairs of contacts so arranged that the attendant, of necessity, closes the proper contacts at the proper time, and, vice versa, opens them in their proper order. Thus, the uppermost of the

FIG. 9.—SAGINAW UNION STREET RAILWAY, RAE SYSTEM.

three switches is connected to the trolley wire bus, the central one to the neutral bus and the lower to the ground. In this way the proper connections and disconnections are made automatically.

These constitute the main features of the Rae system, which is now in successful operation in various cities, among them Detroit, Mich., Elkhart, Ind., Fort Worth,

FIG. 8—RAE HORN AMMETER.

Tex., Saginaw, Mich., and other places. The accompanying illustration, Fig. 9, shows a view of one of these roads. It has been remarked that the ease of riding and freedom from noise in the operation of these cars are noteworthy, and the employment of a single motor in place of the customary two is also a feature which the operators of electric railways will appreciate.

BUILDING MOTORS FOR THE SHORT ELECTRIC RAILWAY SYSTEM.

To an electrical engineer few topics are more vital than those which pertain to the design and construction of the apparatus he has to handle in lighting and power. We believe, therefore, that a large number of our readers will be interested in the illustrations and data here given with regard to the apparatus employed for the Short system of electric railways. As the electrical public is aware, this apparatus is built at the extensive works of the Brush Electric Co., in Cleveland. Our admirable contemporay, the *Street Railway Journal*, of whose special field electricity has now taken possession in so remarkable a manner, devotes in its October issue several pages to an illustrated description of the works and their motor product, and has done the thing so well, for its readers, that we are happy to reproduce and abstract some of the matter in the article, for our own.

It will be remembered probably, that in the Short railway system, the familiar Brush machine, that has done so much yeoman and pioneer service as a generator, is employed as a motor. It has, however, been modified in various particulars by Mr. S. H. Short, and now embodies the experience that years of up hill work have given him. As built for railway work, the material for the armature and generator core is thin sheet iron which comes in strips eight feet long and nine inches wide for the generator and five and three-eighths inches wide for the motor. These strips are first rivetted together end to end and wound on a temporary spool, forming a ribbon 920 ft. long for the generator armature and 320 ft. for that of the motor. The spool is then mounted on a shaft and the thin iron ribbon is wound very tightly upon a foundation ring placed in a lathe, as show in Fig. 1, and each concentric ring of the metal is separated or insulated from the other by a strip of manilla paper of the same width, wound off a spool placed on the opposite side of the machine. Two workmen attend to the winding, and as the spool slowly revolves one of them hammers the layers firmly together. As the splice comes in, the machine is stopped for a moment and a small hole is cut in the layer that comes just over the rivetted section so that there is no enlargement of the roll at this point. The ring of the generator when wound weighs 520 lbs. and that of the motor 109 lbs. The object of making the armature cores of laminated instead of solid iron is of course to prevent the generation of eddy currents

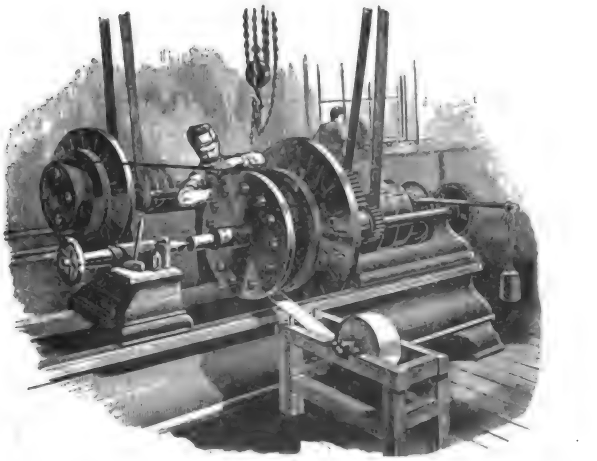


FIG. 1.—WINDING IRON CORE OF SHORT RAILWAY MOTOR.

which would cause the core to heat. The next operation is to drill through the rim of the ring in the direction of the centre, and then rivet the layers and foundation ring firmly together. The rings are then taken to the milling machines, of which there are six for this purpose and one of which is shown in Fig. 2, and pockets or slots are milled in each edge of the rim as shown. In the generator ring forty-eight slots are milled. These are spaced at irregular intervals, but are usually about an inch apart, one-half inch

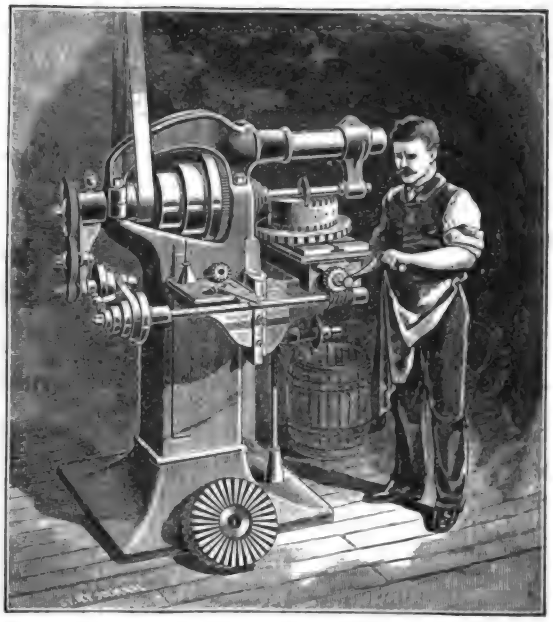


FIG. 2.—MILLING SLOTS IN ARMATURE CORE.

wide and nearly two inches deep. In the motor ring are thirty-two slots.

After leaving the milling machines the slots are smoothed up with a file, the corners of the base are rounded off and the ring is ready for the winding.

Fig. 3 illustrates the method of winding the armatures. Three men work together on the large one, which is about two feet in diameter, and one on the motor armature which is one foot in diameter. The winding consists in placing a number of coils of insulated wire around the rim within the slots, and when wound the wire in each slot is called a "bobbin" The wire for the generator is first cut in sections of suitable length, the ends are coiled up for convenience in handling and in the middle a portion of the insulation is removed and a thin metal strip is soldered to the wire. These strips come directly between the slots on the inside of the ring and are provided for connecting the bobbins together. Before winding, the walls of the slot and both surfaces of the ring are carefully covered with insulating material, consisting of asbestos ribbon, rubber cloth and fibrous material having plates of mica between its layers. As the winding proceeds, strips of canvas are placed between the different coils of wire, the wires are tied firmly together, and painted over with shellac varnish. About fifty feet of $\frac{8}{100}$ of an inch wire are required for winding each bobbin on the motor armature, and there are in all thirty-two bobbins. For each of the forty-eight bobbins of the generator fifty-one feet of $\frac{18}{100}$ of an inch wire are required, which is wound in eight coils. It takes one man four days to wind the armature of the motor, and three men six days to wind that of the generator. When finished the ring is baked for about twelve hours in an oven kept at a high temperature by steam heat, for the purpose of drying the shellac. The ends of the wire composing each bobbin are left in a coil of sufficient length, as shown in the figure, to which a small cable is attached for connecting each with the segments of the commutator.

The process of making the commutator is an interesting one. The bars of copper are cast or forged in peculiar shape, usually two inches wide and ten inches long, wedge shaped through their breadth and with fillets near the ends

which are drilled to receive the wires that connect them with the bobbins. The ends of each bobbin are connected with a bar, so that there are as many bars in a commutator

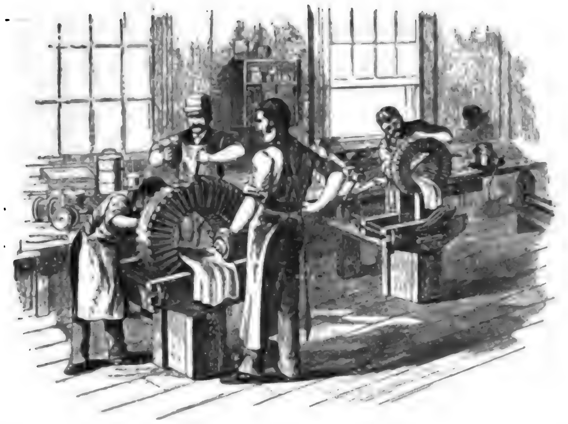


FIG. 3.—WINDING ARMATURE OF SHORT RAILWAY MOTOR.

as there are bobbins. The bars are first set up separated from each other by mica sheets inside of a cast-iron cylinder having numerous threaded bolts through the shell. When all are arranged the bolts are turned up and the bars are brought firmly together and held by shellac and other cementing material. The mica for this work is the best imported India, and is prepared with great care. It is carefully split and inspected, and in making up a plate, which is about one-sixteenth of an inch in thickness, several sheets from different blocks are placed together so as to prevent the possibility of forming a short circuit between any two bars by means of any bit of iron ore that might be in the mica. Each sheet is covered with shellac and the plates are baked to harden the varnish before using.

When completed in the above manner the surface is turned off and polished till it is very smooth and true, and the separate bars are drilled at their ends for receiving the connecting cables.

At another table in the machine shop is witnessed the operation of placing the hub or bearing in the armature. The hub is made of German silver and consists of a sleeve or thimble having four short thin spokes, the outer edges of which are designed to fit in narrow grooves cut on the inner surface of the foundation rings. These are then keyed in and the armature and commutator are ready for mounting on their shafts.

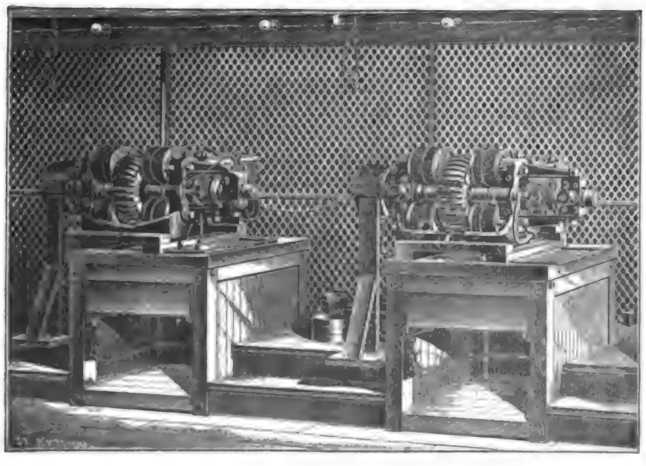


FIG. 4.—STAND FOR TESTING MOTORS.

While we have been watching the above operation a number of men and machines have been at work turning up the generator and motor shafts. Seven lathes are required for this work, and there are three machines making collars and nuts for the shafts. The shaft with its armature and commutator now goes to the connecting room, where the bobbins are connected with the bars of the commutator. Here are a number of young men at work; some are soldering the connecting cables to the coils of the bobbins; others are rivetting the other ends to the commutator bars. The connecting cables are about two feet long, one-eighth of an inch in diameter, and are made of eighty-four exceedingly fine copper wires—No. 50, almost as fine as horse hair.

In an adjoining room—the "kindergarten department" it is called—are a dozen small boys making up these cables. The wire comes braided into a large cable, nearly an inch in diameter, and the boys count out the number for each connection, twist them into a rope and cover it with rubber cloth.

The connections being made, the connecting cables are bound firmly to the shaft and covered with canvas and wire, and with water-proof material. Formerly it was the custom to drill the shaft and lead the connecting wires through the bore to the commutator, but now the bearing is placed outside the armature and the wires are led along the shaft as above.

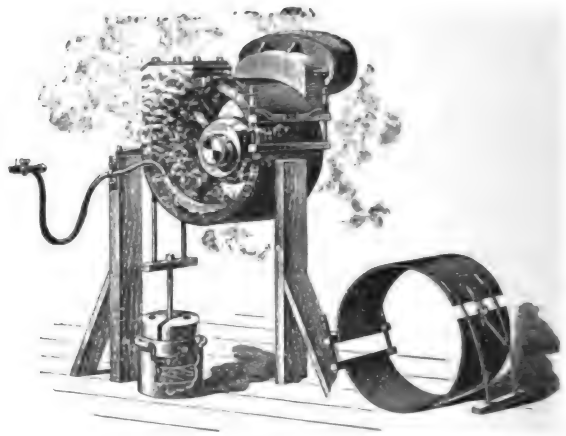


FIG. 5.—TESTING MOTORS BY BRAKE METHOD.

The testing department is next visited, and here provision is made for testing three armatures at a time. The shaft is mounted in its frame with the armature in position between the field magnets, and is connected to a circuit which is fed from a generator running in another part of the building. Fig. 4 illustrates these machines, but shows only two of the three in the room. Here all the conditions of actual work are imposed upon the motor. To the end of the shaft a hollow pulley about one foot in diameter is keyed, and this is embraced by a band or ring of thin metal having clamps, by means of which this band may be tightened to cause it to act as a brake. Attached to this ring is a suspended rod upon which weights may be placed, Fig. 5. Upon a table near by are volt and ampere meters, from which frequent readings are taken. A rheostat is also provided, the same as those placed upon the car. The current being turned on, the motor is allowed to run idle for a time and the speed or number of revolutions per minute is recorded, as are also the meter readings.

Then a fifty-pound weight is added to the brake and another reading is taken. Then fifty pounds more, and still another fifty before the test is ended. The brake is clamped just tight enough to cause it to hold suspended 150 lbs. A hose is provided as shown, by means of which a small stream of water is fed within the hollow pulley, to cool off the parts which otherwise would become very hot from the friction of the band upon the pulley. The period

of test for each motor is one hour, and none are passed that do not show an output of over fifteen h. p.

This brake and means of testing a motor or generator was the invention of Mr. Brush and is most simple and effective.

The wooden web gear wheels, a specialty in these motors, render their operation almost noiseless and also assist in the insulation. These wheels consist of a steel ring about eighteen inches in diameter, having a wooden web, instead of spokes, to which the hub is bolted, and which is strengthened by circular plates bolted through the web and made to embrace the inner fillet of the ring. The web is made from thoroughly seasoned oak boards about one inch thick, cut into triangular shaped pieces, carefully fitted and glued together and turned down to a wheel of suitable diameter. Two of these are then placed together face to face so as to break joints, thoroughly soaked in oil and carefully finished and polished. These are then fitted to the steel ring, drilled for the bolts, and the hub and sustaining plates are bolted on. The last gear wheel in the train, or the one that is mounted on the car axle, is "split" and provided with ears and bolts for holding the two halves together and for securing them firmly to the axle.

The webs having been fitted, the blanks are taken to a second machine shop on the first floor of the "Cathedral" building, where the gear teeth or cogs are cut or milled out. Here are six specially designed automatic gear cutters or milling machines for cutting the teeth on the gears and steel pinions. Four separate cuts are required to finish a tooth.

So thoroughly are these machines designed that when a blank gear or pinion is set they will cut all the teeth without further attention and ring a bell when the last cut is made. On some of the machines two blanks are placed face to face and the tool cuts across the face of both. The small six inch wheels which are mounted on the armature shaft and the intermediate shaft are called pinions. These are of solid steel or rawhide and are to be distinguished from the intermediate wooden web gear.

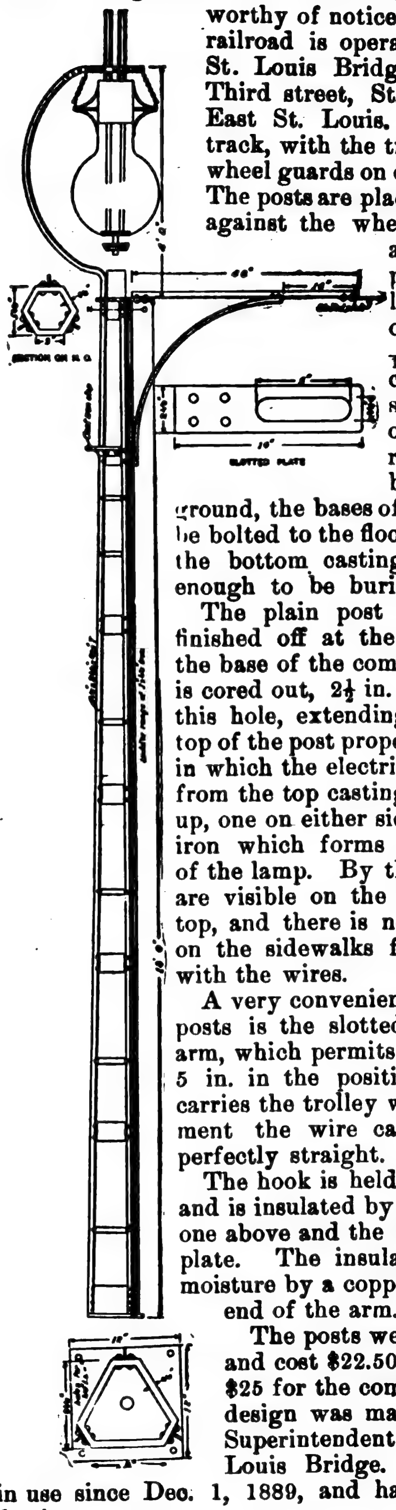
The field magnets of the generator and motor next claim attention. As before stated, there are four of these to each machine, and they are so mounted that the poles are presented to the sides of the armature instead of to the face. The core is of soft cast iron of peculiar shape, the pole shoe being widened out in the form of a crescent. The opposite faces of the field magnets are planed smooth and parallel on specially designed milling machines. Three or four magnets are placed in line on the bed of the machine and are passed between the faces of two revolving circular tools.

After being planed the magnets are taken to the winding room, but before winding each field is covered with a closely fitting thimble or shield of copper. This shield is designed to prevent the inductive spark piercing the fields, and is a special feature in the Brush machine. The fields of the generator are compound wound. The shunt coil consists of 225 lbs. of .072 wire wound in a coil of eighty-three turns of seventeen layers. The series coil requires fifty-eight pounds of .180 wire, and it is wound in eighty-three turns of forty-four layers. The winding completed, the coils are covered with shellac varnish and canvas, and the fields are placed in a hot oven until the varnish is thoroughly dried. When wound ready for service each of the generator fields weighs about 2,692 lbs. and the motor fields about 1,820 lbs. each.

The motor frames are carefully designed and are another special feature of the Short system. The frame is cast in two parts, and the parts are held together by means of wooden blocks about six inches square and eighteen inches long, fitting the sockets to which each part is firmly bolted. The wood renders the frame very rigid and serves to insulate the motor proper from the car axle.

COMBINED ELECTRIC RAILWAY AND LAMP POST.[1]

The St. Louis & East St. Louis Electric Railway, operating the Thomson-Houston system, employ a type of pole which has given considerable satisfaction, and is therefore worthy of notice. The above mentioned railroad is operated at present over the St. Louis Bridge and approaches from Third street, St. Louis, to Broadway, East St. Louis. The road is a double track, with the tracks laid alongside the wheel guards on either side of the bridge. The posts are placed on the sidewalk close against the wheel guard, 125 ft. apart, and about every fourth post carries an electric light. Each post is made of three $1\frac{1}{2}$ in. x $2\frac{1}{2}$ in. x $\frac{5}{16}$ in. T irons riveted to cast-iron blocks of the shapes and sizes shown on the drawing. As the road is entirely on the bridge and not on the ground, the bases of the posts were made to be bolted to the floor; for use on the ground the bottom castings could be made long enough to be buried in the earth.



The plain post (carrying no light) is finished off at the top by an acorn. In the base of the combined lamp post a hole is cored out, $2\frac{1}{2}$ in. in diameter. Through this hole, extending from the base to the top of the post proper, is carried an iron pipe in which the electric light wires are strung; from the top casting the wires are carried up, one on either side of the stem of the T iron which forms the bracket, to the top of the lamp. By this means no light wires are visible on the pole except at the very top, and there is no danger to passengers on the sidewalks from accidental contact with the wires.

A very convenient arrangement on these posts is the slotted plate at the end of the arm, which permits a lateral movement of 5 in. in the position of the hook which carries the trolley wires. By this arrangement the wire can be readily lined up perfectly straight.

The hook is held in place by jam nuts, and is insulated by two hard rubber plates, one above and the other below the slotted plate. The insulation is protected from moisture by a copper shield rivetted to the end of the arm.

The posts weigh about 300 lbs. each, and cost \$22.50 for the plain posts and \$25 for the combined lamp posts. The design was made in the office of the Superintendent of Structure of the St. Louis Bridge. The posts have been in use since Dec. 1, 1889, and have given perfect satisfaction.

Gutta Percha.—According to a report just made to the French Academy from an expert in the Malay Peninsula, there may be a serious falling off in the gutta percha supply owing to the reckless destruction of even the youngest trees by the natives. Protective and prohibitive measures are advocated.

1. N. W. Eayrs, in *The Railroad Gazette.*

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GEO. M. PHELPS, President. F. R. COLVIN, Treas and Business Manager.

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.

Western Manager, W. F. COLLINS, Temple Court, 225 Dearborn Street, Chicago, Ill.

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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

VOL. X. NEW YORK, OCTOBER 15, 1890. No. 128

A definite object in view, and a well-directed perseverance in overcoming the difficulties by which the path is usually obstructed—these are indeed the conditions of successful invention.—Lord Rayleigh.

THE DRIFT OF ELECTRIC RAILWAY WORK.

THIS week at Buffalo the street railway people of the country are gathered together for their annual convention, and the meeting will be one of great importance. Not only is Buffalo, at this very minute, the scene of new electric railway construction of the first magnitude, involving the outlay of hundreds of thousands of dollars, but the leading topic of the occasion is electricity in its application to street railways.

To those who are familiar with the condition and tendency of things, this attitude of the street railway men is no cause for wonder. Already more than 30 per cent. of the street railways of the United States are definitely committed to electric traction, and the rate of growth is continually more rapid as the new companies give in their adhesion. Thanks to the superior economy and efficiency of the electric systems, roads are now being established by the score that were previously hopeless. Many old roads that were failures with horses have entered upon a prosperous career with motors. Any number of instances can be named where the introduction of a new electric road has built up desirable new suburbs for crowded city dwellers, and has more than paid for itself out of the immediate appreciation in value of meadow land and plowed fields. Already the operation by electricity of the steam service in the "commuting" districts around our large cities is being discussed, figured over and negotiated with the most serious intent.

With the coming of the electric cars there has been seen a most notable advance in the comfort and convenience of the service. The big horse stables, with their "area of smell," have been banished to make room for steam plants, in which will be found examples of the very latest and finest products of mechanical engineering, solid, clean and sightly, employing higher-paid skill and intelligence. The cars themselves are improved. A great many are lighted electrically; not a few are warmed electrically; nearly all run smoothly on new road-beds, and several of them, when made up in trains, are vestibuled. A leading citizen in a Western town a few weeks ago, took a ride on the starting up of the new electric road. He was not a stockholder, but he owned property in the place and was interested in its welfare. So pleased was he with the ride and the luxury of the car, as well as with the evident effect for good on the locality, that he took out his check-book, drew a check for $100 and turned it in as his fare.

All this, however, is but the beginning, and as the new work goes on improvements will be seen in quick succession. Our present issue shows how great are the strides now being made in the lessening of noise, the lightening of apparatus, the perfecting of overhead trolley appliances, and the control of car mechanism. The resort to aluminum, now brought within reach by its lower price, promises an enormous economy in the long run by the smaller demand that will be made on the power house or storage cell for current.

Nor is it to be believed that the overhead system will maintain its present excessive proportion of the work. That it will long prevail, even in the larger cities, is quite likely; but the drift is decidedly away from it and towards systems of conduit or storage operation. As some figures, cited elsewhere in our columns, show, there are practically as many storage cars running to-day as there were of the overhead system only two short years ago; and there will be more. In such a city as New Orleans, for example, the storage system is the only substitute for horses, and there it will achieve one of its greatest triumphs. And then it is not to be supposed that the conduit systems will remain untried, especially such an one as we described a week or two ago, in which every section but that the car is traveling over is cut out and remains "dead" till energized by the next car.

The evidence collected by one of the Boston daily papers from cities in which electric roads are running proves beyond a shadow of doubt the immense popularity of the new system, as well as its great freedom from danger and causes of annoyance to the public. This ready appreciation serves as a stimulus in the work of improvement yet to be carried out. Electricity should brighten, beautify and better everything that it touches, and in no field will it do this to greater admiration of all than in that of street railway traction. Meanwhile, as we have hinted, electrical engineers are learning lessons and gathering strength for the kindred work that they have already been called upon to take up, namely, the operation not merely of local roads, but of roads running from point to point a distance of thirty or forty miles, or even more.

THE CENTRAL STATION OF THE FUTURE.

The history of the changes and transitions which have taken place in the last ten years in the distribution of current for all purposes, point in no uncertain manner to the status which the industry will occupy in the future, and the methods of management which will be adopted in its conduct. Arc lighting, which was the first to occupy the field, had become fairly well established as an industry when the incandescent light was brought forward as a direct competitor with gas, but it required several years to convince the majority of the operators of central station arc plants to recognize the incandescent light field as one desirable to cultivate, and, as a consequence, it devolved upon newcomers to undertake this part of the work. The success which was soon met with, however, convinced the former scoffers of their error, and as a result we find, in numerous instances, central stations combining both methods of illumination in their work. The advent of the electric motor added another chapter to the history of development, a chapter in many respects similar to that of the incandescent light, beginning with a period of doubt and hesitation and now rapidly ending to conviction, due to results which have been demonstrated beyond peradventure. Now that the electric railway has entered the field as a consumer of current, it seems proper to inquire, if, with the experience of the past as a guide, the methods in vogue at present are the best or are likely to endure? With but few exceptions the roads now running are equipped with power plants of their own, notwithstanding the fact that in many cases electric central stations are in operation in the same towns having a large, if not their entire, power equipment idle during the day time. This state of affairs is one which it seems hard to reconcile with the principle of economy. The benefits to be derived from concentrating the sources of electric current for all purposes of distribution under one roof and one management have, we believe, been recognized but in few instances; but we know that the success attained has been, as it was easy to foresee, phenomenal. Indeed, the matter is one of simple calculation, and we believe that the time is not far distant when, at least in the smaller towns and cities, the supply of current for lighting and power of every description will be distributed from one point for each district, and with marked economy.

CO-OPERATION IN ELECTRIC WORK.

The recent fire in the Western Union Building in this city and the quick recovery from practical extinction of the service to full operation has justly been commented on and praised by experts as an excellent piece of work, demonstrating the ability and energy of those upon whose shoulders the burden rested. The manner in which the frightful confusion was, in a few days, converted into an orderly arrangement, is very graphically described by Mr. A. C. Robbins, in the paper read before the Electrical Section of the Brooklyn Institute, which we print elsewhere. The wiping out of this great central station, notwithstanding its situation in what was considered a fireproof building, naturally leads to the thought that a similar accident may occur in other places, with equally disastrous consequences. This truth applies generally to all telegraph stations. Few may have stopped to consider, however, what would be the consequences of the complete destruction of one of our large costly telephone exchanges, such as are now in operation in several important cities, and connecting with thousands of subscribers. In the case of the Western Union fire it took but a few weeks to connect the few hundreds of circuits to the proper instruments; but even those little acquainted with multiple switch board work must realize that the connection and cross-connections required for two or three thousand subscribers would require months of labor. The inconvenience created by an interruption of such a long duration would seem to make it worth while to guard in every possible way against such an occurrence. Evidently the main feature of the exchange is the switch board, and to wait for its construction, not to mention the time required for setting up and connecting it, would be adding another and fatal loss of time. With these facts before us, it seems proper to suggest that much time and annoyance might be saved by the maintenance in reserve of switch boards, thoroughly equipped, which could be set up at a moment's notice and be ready for work by the mere connection of the line circuits to the proper terminals. It might be argued, however, that while the plan is a good one, the great cost of a switch board capable of accommodating several thousand subscribers, and aggregating over $100,000 in cost would make the scheme financially impracticable. But we think that there is a very simple way in which the plan could be worked on the co-operative basis. To that end it would only be necessary for the numerous telephone companies to combine and together contribute to the construction of such reserve boards. The sections of such a board could be distributed at various points so as to be readily accessible to exchanges in any particular district, while, on the other hand, they could be quickly concentrated at any one point, if required. The plan, if carried out on this basis, would be a new form of mutual insurance which could be obtained with comparatively small cost to each individual company. Thus the chances of interruption of service will be reduced to a minimum.

Novel Uses for Incandescent Lamps.

Not only are incandescent lamps now being used by the million in public buildings and in private houses, as well as in such structural decorative effects as "towers of light" and triumphal arches, but they invite the ingenious inventor and engineer to a variety of novel experiments. Thus, in this issue mention is made of the use of the flashing of incandescent lamps, by the automatic opening and closing of the circuit, to record visually the number of sheets printed by newspaper presses. Another striking novelty is that which will adorn the new marble building of the Penn Mutual Life Company in Philadelphia. The huge clock on the tower, instead of having an illuminated dial with dark hands, will have a dark face with enormous pointers of light. These pointers will be made of glass over an iron frame and be rendered plainly visible for miles, by incandescent lights, which will give them the appearance of slender white rods of fire.

THE WEUSTE TELEMETER.

THERE are many situations in which it is desirable to have an indication or obtain a record of the condition of apparatus situated at a distance, and for this purpose the variety of instruments has been designed in the past. The favorite method for obtaining such indications at a distance, and indeed the most convenient, is evidently by means of electricity; the apparatus required being simply an instrument which shall be affected by the varying conditions of which it is desired to have a record, and at the other end of the line a receiving instrument or indicator actuated by the impulses transmitted from the first station.

Among the apparatus recently brought out for this purpose, such as the indication of the height of water in reservoirs or of gas tanks or the position of elevators, and the like, is one due to Mr. Chr. Weuste, of Muelheim, Germany, and which has been patented in this country.

The object of the inventor has been to make the apparatus as simple and absolute in its action as possible. The manner in which this has been carried out is shown in the accompanying engraving, Fig. 1, which shows the appar-

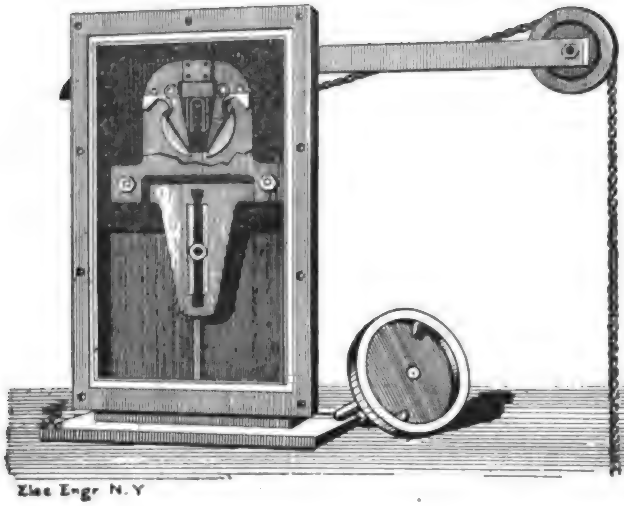


FIG. 1.—THE WEUSTE TELEMETER.

atus in perspective, and Figs. 2 and 3 illustrate the principal working parts in detail. The apparatus consists of a short cup-shaped cylinder, *a*, mounted horizontally on the shaft; and suspended from its lower end by means of a pin, *b*, is a rod, *c*, which carries a weight at its lower end, which tends constantly to pull the rod downwards. The cup-shaped cylinder, *a*, is provided with two lugs, *d d*, placed opposite each other, and between the loosely pivoted rods, *h*, are situated the contact points, *f* and *g*.

In the case of a reservoir, for instance, the shaft, *d*, upon which the short cylinder, *a*, is mounted, is wound about with a flexible cord or chain connected with a float. As the water rises or falls it necessarily acts through the cord to turn the cylinder, *a*, and in doing so the lugs, *d*, come in contact with the pin, *b*, and carry the weighted rod, *c*, along with it. This is guided in its upward motion between the cheek pieces, *e*, until the lug reaches the position shown in the diagram, Fig. 2. A slight motion beyond that point allows the weighted lever, *c*, free motion to be drawn down, and it falls in between the cheek piece, *e*, and the loosely pivoted lever, *h*. In doing so it presses the lever, *h*, inwardly and closes the circuit through the contact, *f* or *g*, depending upon the direction in which the cylinder, *a*, was turned. The closing of the contact sends an impulse over the line, which, acting upon the indicating instrument at the other end, makes known the change which has taken place. By means of this arrangement all delicate parts are avoided and the apparatus gives a positive rubbing contact.

It is evident that the fineness of indication can be made as small as desired by diminishing the diameter of the shaft, *d*, upon which the cylinder, *a*, is mounted, so that a

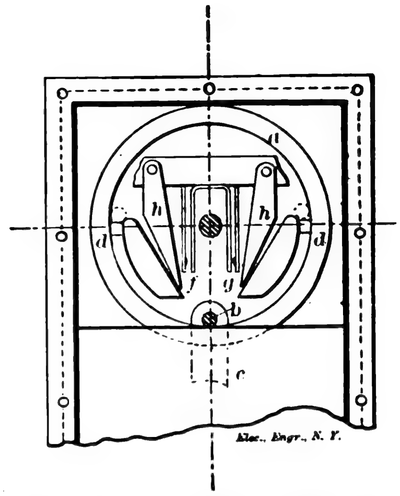


FIG. 2.—THE WEUSTE TELEMETER.

rise or fall of a fraction of an inch may be indicated. A revolution of 90° of the cylinder is all that is required to take the lever, *c*, from its lowest extremity half way up either side. By the addition of an air or glycerine dash-pot the motion of the rod, *c*, can be made as easy as desired. One of the special merits of the apparatus is that a

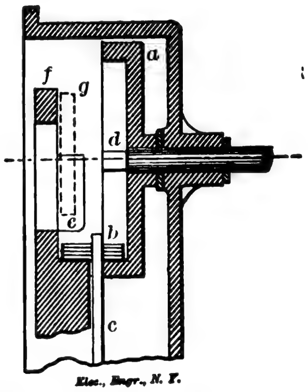


FIG. 3.—THE WEUSTE TELEMETER.

large variation in the level of a reservoir, for instance, in no way affects the proper working of the apparatus, while, as stated above, the fineness of the indication can be made as small as desired.

ELECTRIC LIGHTING AT CHARLESTON, S. C.

Some important changes are contemplated at Charleston, S. C., in the electric light plant of the Charleston Light and Power Co. President Geo. B. Edwards writes us: "Electricity is spreading so fast in the South that this would be a fine location for any manufacturer of electrical supplies. Labor and living are very cheap in this city, and any good manufacturing would pay. This point has also great advantages in freight rates. We are now desirous of selling our present electric light station, either with its whole steam plant of 300 h. p. or with only 100 h. p., as a purchaser may prefer; we moving the other 200 h. p. to the new site. There we intend to erect a 700 h. p. plant, but so constructed as to permit of extensions, without interference with the operating plant." The Charleston Co. has been three years in operation, and it has a capital stock of $50,000. The plant is Thomson-Houston arc and incandescent, run by Putnam engines. Mr. P. P. Toale is secretary and treasurer, and Mr. F. P. Upson, superintendent.

THE WESTINGHOUSE ELECTRIC RAILWAY SYSTEM.

When it was announced a few months ago that the Westinghouse Electric and Mfg. Co. had decided to enter the field of electric railroading much curiosity was evinced as to the type of motor and truck arrangement it was proposed to adopt. Since that time various roads have gone into operation equipped on the Westinghouse system, as for instance at Lansing, Mich., and quite a number of others are in course of construction or under contract. During a recent visit to the works of the company at Pittsburgh, we were afforded an opportunity of inspecting the manufacture of the electric car equipment in every detail and the new features embodied in the apparatus will not fail to interest our readers.

We may say at the outset that, following out the usual practice of the Westinghouse Co., as much care has been bestowed upon the mechanical as upon the electrical part of the apparatus, it being fully recognized that electric railway apparatus, to insure success, must be built in the most substantial manner. With this idea constantly in view there has been developed a combination of elements which together go to make up an exceedingly interesting whole.

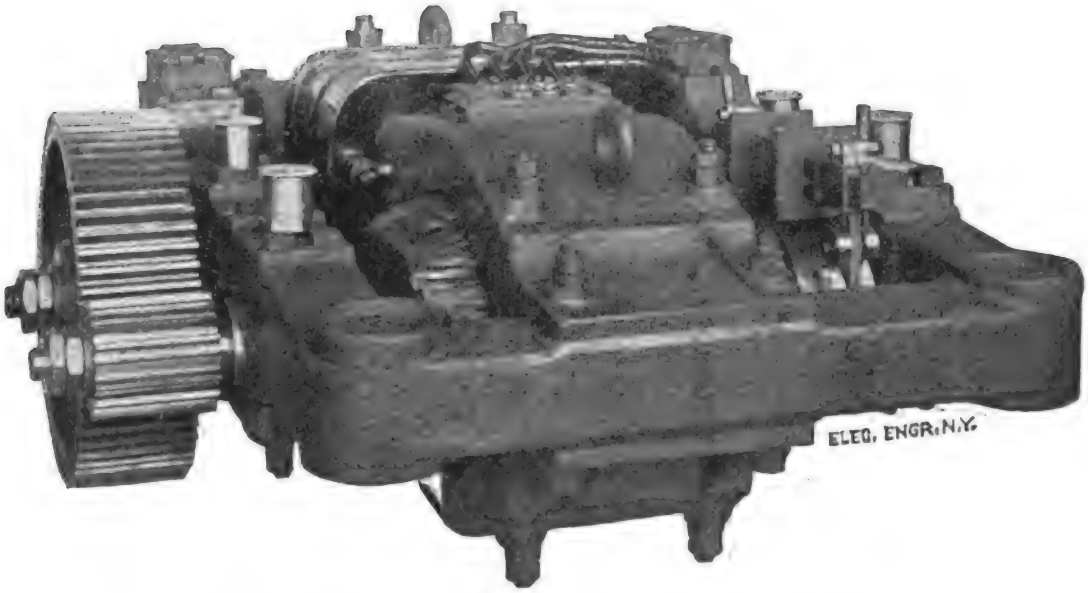


Fig. 3.—Westinghouse Electric Railway Motor and Frame.

The general arrangement adopted is well shown in the plan and elevation of the car truck, as shown in Figs. 1 and 2. Following the now general practice, two 15 h. p. motors are employed, mounted, as shown, with intermediate reducing gear.

One of the most distinguishing features of the new arrangement will at once be recognized in the frame within which the motor is mounted. This will be still more evident by an inspection of Fig. 3, which shows the motor and frame removed from the truck; and by Fig. 4, which shows the iron frame and magnetic circuit of the motor. As will be seen, the frame is carried entirely around the motor, giving a strong mounting and perfect rigidity between the parts of the motor, which are so essential in the street car motor. The gear wheels are placed so as to equally distribute the strains which the motor is called upon to endure, and as will be noticed, the gearing is mounted closely to the frame so as to eliminate the objectionable buckling and tendency to loosening of parts. The gears are incased in a dust-proof box partially filled with oil, which reduces the objectionable noise to a minimum and increases enormously the life of the gears. The oil boxes which are used for lubricating the car axle are filled with waste, and a thick grade of oil is used here, the same as in the car boxes of the truck. A hinged cap is placed over this box, thereby rendering the same dust-proof. The oiling of the other two bearings is done by means of a thick grease, and the grease-box is sunk down under the castings so that there is no part to project or to be injured by rough handling.

It will also be noticed in this frame, that the armature, and the intermediate shaft are taken out from below. The reason of this will be evident when it is considered that the car body is always placed over the truck, and whenever any changes are to be made from accidents or for general inspection and repairs, the car is run over a pit, the working parts being then usually removed from below the frame instead of above.

This frame is suspended at the two corners, upon springs, which give it a flexible support. This flexibility is not considered to be at all essential; at the same time, it is supposed that the motor rides somewhat easier on account of the springs.

Special machinery has been devised for boring out the castings on the side of the frame where the three shafts pass through it. This machinery is so devised that any frame is interchangeable with any other. The advantage of this is obvious when repairs become necessary. The ridges, of which four will be noticed on the top of the frame, are arranged to hold the heads of the bolts, to prevent the same from turning and thereby becoming loose.

We now come to the magnetic part of the frame, which is clearly shown in Fig. 4. The field castings, it will be seen, are made of one piece and hinged at the rear end upon the yoke or keeper. The fields are loosely hinged for ready removal, but when put together are bolted tightly and make intimate contact with the keeper which is planed to receive them, the joint having a surface of 40 square inches. The fields are made with very little curve at the pole-pieces, so that the coils, which are wound separately, can be easily slipped on. Separating the pole-pieces is a suspension piece of brass which breaks the continuity of the magnetic circuit and causes the magnetic lines to follow through the armature. Thus it will be seen that but five castings are employed to make up the frame, keeper, fields and suspension piece, of which two are alike.

Among the other advantages gained by this construction is the great ease with which all parts, especially the heavy ones, can be gotten at for inspection and repairs, and in virtue of which it is never necessary to remove from the

car axle any of the heavy parts in the case of repairing the armature, field coils, or the replacing of bearings or gears. Thus, if it should be necessary to remove one of the field coils from the upper field casting, all that is necessary is to remove the trap door from the floor of the car, loosen the bolts which hold the field casting down, raise the forward end upon its hinge, and slide off the field coil. The lower field coils can be removed by allowing the lower field casting to swing down into the pit where they can be removed over the casting. The manner in which this is done is indicated in Fig. 5, which shows the pole-pieces swung out of the way, exposing the armature. A sling can be placed about the armature, and that can be lowered into the pit; and the same method of removal is also true of the intermediate shaft and gears and boxes.

The armature employed is of the Siemens type and special precautions have been taken to avoid every possible trouble at the commutator. For this purpose it is constructed entirely of brass and fibre so that no unequal expansion with change of temperature can take place. Each segment besides being insulated from the next segment by mica plates, has underneath a bearing surface for its entire length, so that it cannot bend down, or move out of place. The commutator bars are cast by a special process, the cast bars being preferred on account of the hard granular structure produced.

The motor, which is series wound, has two sets of coils on each field magnet, and the speed is varied by these in connection with a rheostat, or current "diverter," as it is called. This is composed of three separate coils, but, unlike the German silver or iron coils usually employed, they are wound of copper wire, cotton covered. The wire is wound on these insulating cylinders, separated from each other by an air space, and is thoroughly insulated and made practically water-proof. The employment of copper wire as a resistance coil might at first sight appear anomalous, but experiments undertaken by the company have shown that the necessarily increased length of wire required also affords a far greater surface for radiation, so that the elevation of temperature is greatly diminished as compared with German silver or iron. Again, the variation in resistance due to this change of temperature is, in consequence,

Fig. 4.—Magnetic Circuit and Frame, Westinghouse Railway System.

also kept down to a minimum, thus avoiding irregular action in the rheostat due to changing resistance. Above all, however, practical experience has shown that the "diverter" requires so little labor in its construction, and weighs so much less, that it can be built at a lower cost.

The arrangement adopted for the brush holders has also been very neatly worked out. It consists of a square oak holder attached to the side of the frame and carrying brush holders which are clamped so that they can be readily adjusted. The carbon brushes are placed in a sliding frame and are pressed against the commutator by a pair of springs which can be released by a pressure of the finger, and the carbon slipped out for replacement when worn. The mechanical details of the running gear also deserve notice. Thus, the main axle gears are made with solid webs instead of spokes. All care possible is taken that every

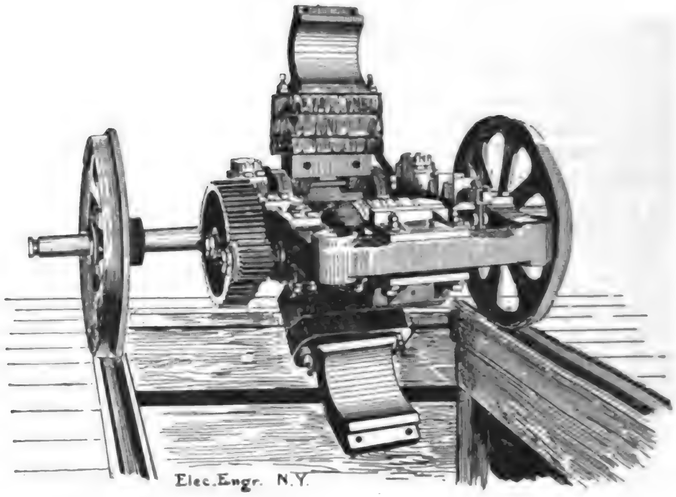


Fig. 5.—Westinghouse Railway Truck over Pit.

gear is free from flaws, and is cut with the utmost precision. The hole is tapered, and a jig is inserted in each gear before it is sent out to make sure that it will fit perfectly upon the car axle. In addition to this, a circular jig has been sent to the principal truck builders with the request that they make their car axle to conform with this jig. This is done to insure a perfect fit.

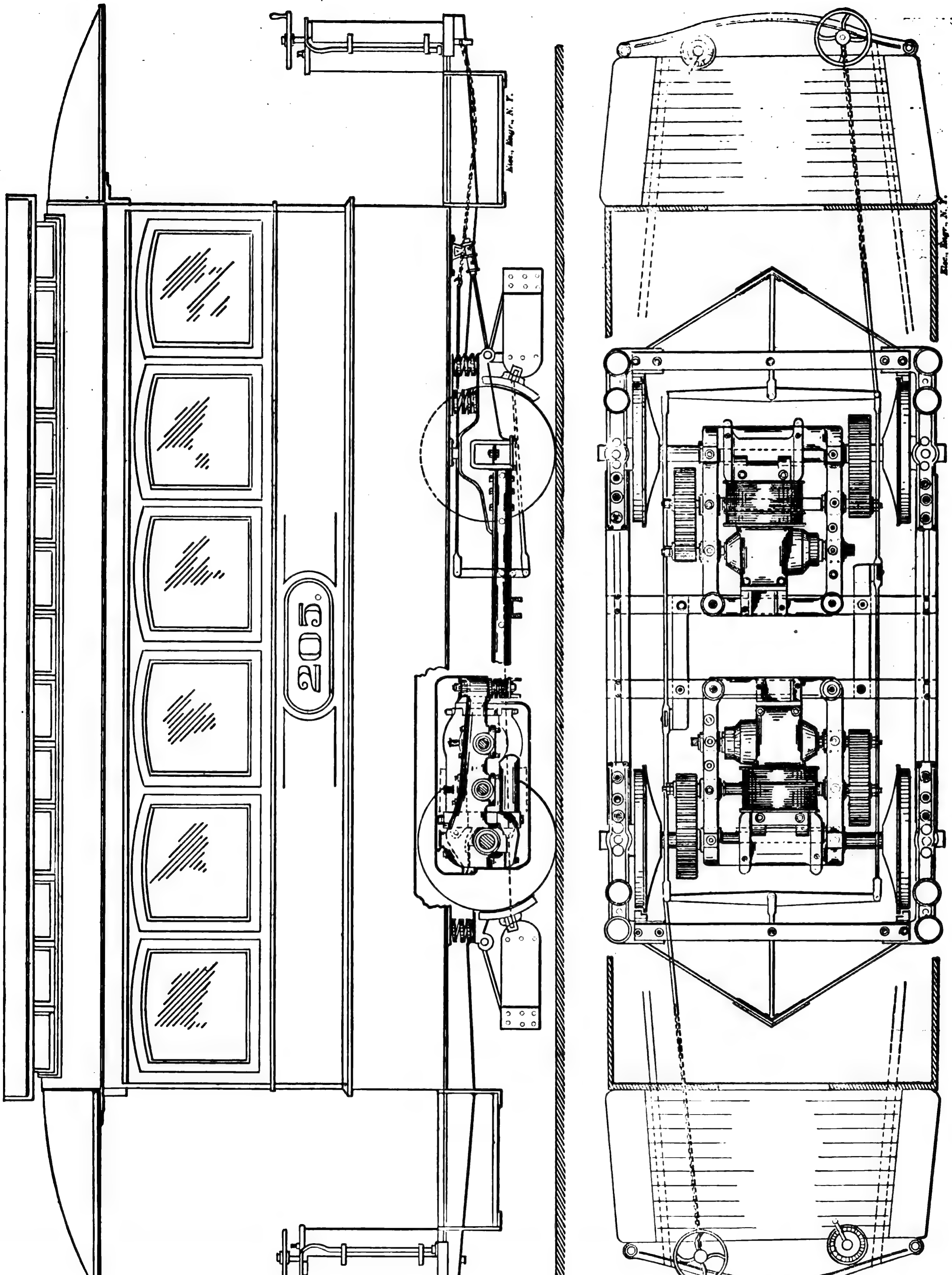
The armature pinions are made of solid steel forgings which are carefully cut and tested before being sent out. With this combination of material and running in oil, encased in a dust-proof box, the life of the gears ought to be considerable. Another interesting method of construction is that adopted for the bearing of the pinions on the motor shaft.

One of the difficulties encountered in railroad work has been the heating of the pinion and consequent expansion and loosening on the shaft which causes a rattling of the gears. To overcome this, the end of the shaft is tapered and provided with a feather, then a spring washer, two nuts and a split pin or cotter, placed at the end of the shaft. If the pinion, which is cut with a taper hole, becomes heated on this tapered shaft, the lock-washer forces it along the taper, thereby always making a perfect fit and bearing. Another great advantage of this taper, is the ease with which a pinion can be removed from the end of the shaft without the difficulty experienced with a straight bearing.

It would lead us too far to enter into the smaller details of construction embodied in the system, but during our visit to the Works, we were impressed with the thoroughness of construction adopted in all the work, and the care which is given to the insuring of good contacts and insulation.

INSPECTING SIGNAL SERVICE STATIONS.

Second Lieut. Frederick R. Day, Signal Corps, now on duty at St. Louis, Mo., has been ordered to proceed to the following named points and make a thorough inspection of the Signal Service stations located thereat, in accordance with such special instructions as he may receive from the Chief Signal Officer, and having completed the inspection at the point last named, will return to his proper station and resume his duties: At Cairo, Ill.; Memphis, Tenn.; University, and Vicksburg, Miss.; Shreveport, La.; Palestine, Galveston, Corpus Christi, Brownsville, Rio Grande City, San Antonio, and Abilene, Texas; Fort Sill, Oklahoma Territory, and Fort Smith, Arkansas. Lieut. Day is authorized to inspect and to condemn and destroy, if found worthless, such unserviceable Signal Service property at the stations visited (for which he is not responsible) as may need the action of an inspector.



Figs. 1 and 2.—Westinghouse Electric Street Car.—Plan and Elevation.

THE COEFFICIENT OF MUTUAL INDUCTION OF TWO PARALLEL WIRES.

BY DR. CARY T. HUTCHINSON.

CONSIDER two wires running parallel for a distance, l, and at a distance, d, apart. Then, neglecting the effect of the return circuits, it can easily be shown that the coefficient of mutual induction—

$$M \propto \left[l \log_e \frac{l+\sqrt{l^2+d^2}}{d} - \sqrt{l^2+d^2} + d \right] \quad (1)$$

Assume, further, that $\frac{d}{l}$ is a negligibly small quantity in comparison with 5 per cent. which is the limit beyond which I do not go ; then this reduces to

$$M \propto l \left[\log_e \frac{2\,l}{d} - 1 \right]$$

or

$$M \propto l \left[2.3 \log_{10} \frac{2\,l}{d} - 1 \right]. \quad (2)$$

This expression would represent, in the simplest conceivable case, the dependence of the disturbing effect of a telegraph or trolley line upon the geometrical constants of the circuits. In applying it to actual cases, the effect of the various telephone wires upon each other and the effect of electrostatic induction, are the most important factors neglected ; the latter, indeed, has been shown experimentally to be the dominant factor in some cases ; yet it is probable that in the actual case the general form of the expression for M would be similar to the above.

The equation shows that the effect varies directly as the distance of parallelism only when the ratio of this distance to the distance apart is kept constant ; that is, if the distance of parallelism is doubled, the distance apart being kept constant, the effect will be considerably more than doubled ; but if the distance apart be doubled at the same time, then the effect, always to the degree of approximation mentioned, will be doubled.

A simple consideration shows this to be true. The coefficient of mutual induction is proportional to the number of lines of force linked with both circuits ; if then the distance of parallelism and the distance apart be increased in the same ratio, the proportion of lines linked to total lines in one circuit, will be approximately the same, but the absolute number of lines, upon which M depends, will be doubled. In no case does the effect vary inversely as the distance apart.

The following numerical table shows all this clearly ; it is calculated from (2), the numbers given for M being only proportional, not absolute values :

TABLE.

No.	l (feet).	d (feet).	l/d	$M \propto$
1	10,000	20	500	200
2	5,000	20	250	88
3	2,500	20	125	38
4	1,000	20	50	12
5	500	20	25	5
6	5,000	10	500	100
7	5,000	20	250	88
8	5,000	30	167	81
9	5,000	40	125	77
10	5,000	50	100	73
11	5,000	100	50	61

Comparing Nos. 1 and 5 shows that increasing the distance 20-fold increases the effect 40-fold ; Nos. 2 and 5 show that increasing the distance 10-fold increases the effect 17-fold, when the distance apart is constant. When the length of parallelism is constant, Nos. 6 and 11 show that increasing the distance apart 10-fold diminishes the effect only to .61, and not to .1. This makes the case for telephones very bad, and shows the necessity for metallic circuits—for the telephones, of course.

SIMPLE SAFEGUARDS ON ELECTRIC RAILWAYS.

BY M. C. SULLIVAN.

JUST at this juncture, when so much attention is rivetted upon the subject of electric railroads, a plain word or two from one who is in circulation all the time and has many opportunities of observation, may not be out of place if it help toward needed changes and improvements. The exploiters of electrical novelties and inventions must always be ready to justify and increase the confidence of the public by hastening to remove all possible sources of annoyance and inconvenience.

Let us take, for instance, the subject of overhead trolley wires, which are often so strenuously objected to, yet which have proved such a boon by the increase of traveling facilities they have brought, with concurrent advantages. These wires are generally strongly set up, but owing to their peculiar construction they often act as a catch net for the vagrant wires of other electric services. The current of a street railway circuit, while not dangerous to life, is of necessity not very pleasant, and a "dead" wire dropping across the trolley wire at once becomes very much alive. In this condition it dangles in the air, or trails along the ground to all appearances a harmless relic, until some generous person volunteers to remove it, and then there is usually trouble. Nor does it help matters to have one excited citizen after another receive severe shocks in their efforts to clear away the obstruction, until after, may be, hours of delay the "expert" comes along arrayed in all the glory of his rubber gloves. Then he fondles the wire as though it were indeed dead, seeking at the same time to make the ceremony very awful and impressive. The newspapers will come out next day in inch full-face head lines announcing "The Deadly Wire Again," "Volts on the Rampage," etc., until the people are led to believe that the wires which have proved such a blessing are disguised messengers of death, and that travel by means of electric railways is bald-headed suicide.

It is of little use, however, to complain of the exaggeration and sensationalism of the papers. That is what they are here for. The source of annoyance does exist, and it is for us to remedy it if possible. The question of how this can best be accomplished, is answered by the necessities of the case, namely, the removal of the offending wire. To do this with the bare hands is not to be considered, for it is well known that a person cannot stand a railway shock for any length of time. He could, however, if his hands were protected by the best known insulation for the purpose, rubber gloves. Each car on a well equipped and well operated road should be supplied with these simple, but very valuable adjuncts. Their use will save annoyance, and heavy electric shocks, and at the same time save the company a great deal of wasted time and adverse criticism. A pair of insulated pliers and nippers should also be considered as a part of the car's equipment. The gloves especially should be kept in sight of the passengers, in the same manner that wrecking tools are carried on our railway trains, and that fire extinguishers are kept at convenient points in office buildings. Nobody avoids the trains or buildings on their account. A small placard indicating that these appliances are to be used in the handling of an electric wire should be placed in full view. It seldom, if ever, happens that there is not among a carload of passengers one or more who know enough of electricity to safely remove an obstruction of the kind I have named if they have the right protection. Besides the drivers and conductors are there.

This may seem a trivial matter when we consider how slight is the remedy required, but it is of as much consequence viewed from the standpoint of the people whose servants we are and whom we wish to please. If an accident occurs along our lines, the pessimists, who look with disfavor on all steps of progress, open their vials of wrath upon us; while the newspapers, glad of the opportunity of getting hold of a small incident that may be magnified a thousand times, and about which hangs an air of mystery, will energetically endeavor to make the most of the occasion.

In a word, I would suggest the supplying to each car operated by the electric current a pair of rubber gloves, insulated pliers and nippers, and suitable inscriptions nearby to indicate their use.

LEFFEL TURBINES WITH HORIZONTAL SHAFT.

In view of the great interest that is now being taken everywhere by electrical engineers in the utilization of water powers, we are glad to be able to publish the accompanying illustrations, Figs. 1 and 2. They show a type of wheel now being made by James Leffel & Co., of this city and Springfield, O., the object of which is to dispense entirely with gearing. The connection is made direct to a pulley on the main horizontal, or intermediate, shaft by belting from one or more pulleys on the horizontal shaft of the water wheel.

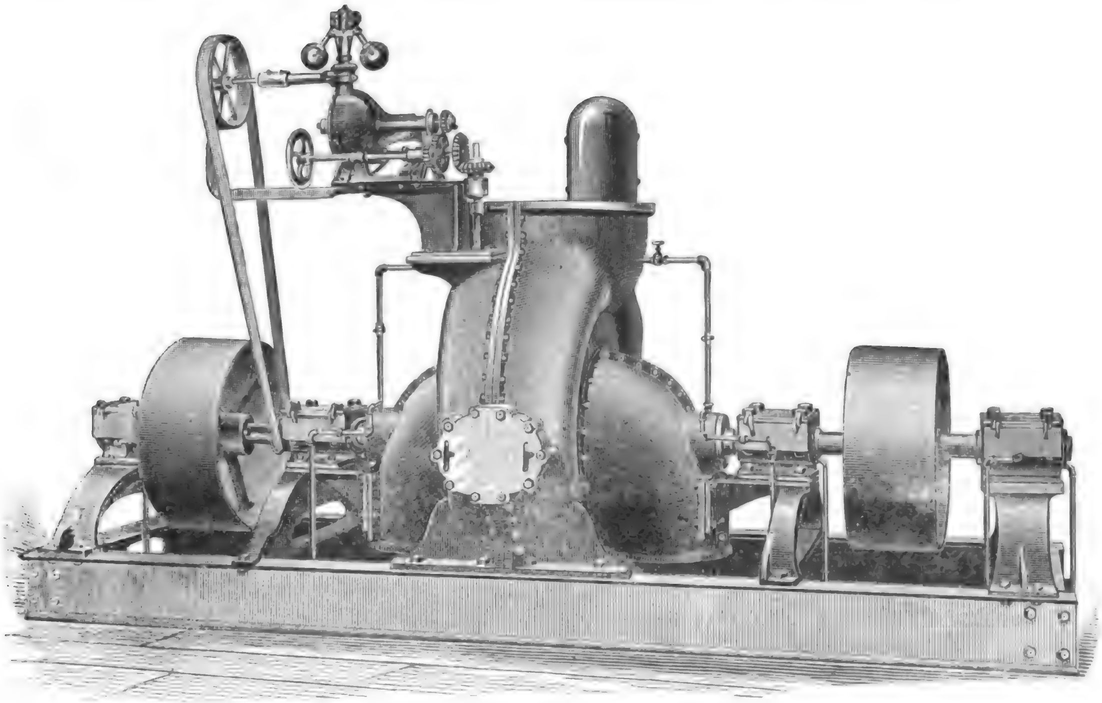


FIG. 1.—DUPLEX DOUBLE DISCHARGE LEFFEL TURBINE.

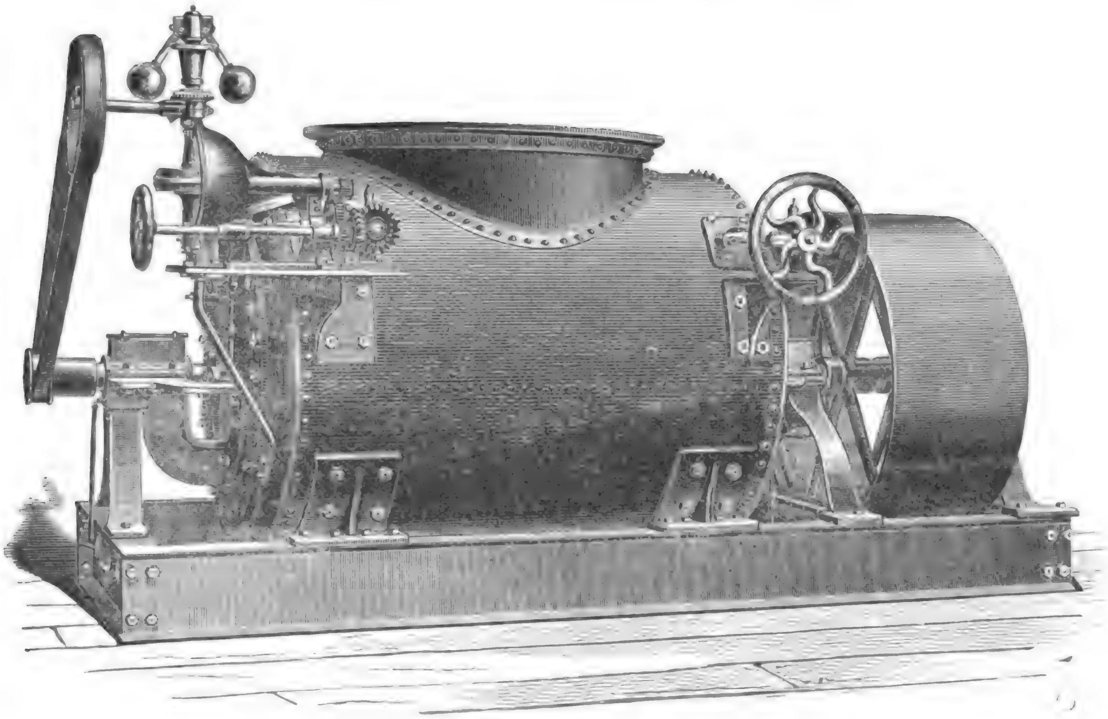


FIG. 2.—TWIN COMBINATION LEFFEL TURBINE.

The application of these wheels occurs most frequently where high heads and small quantities of water, and where very large powers with ordinary high head, are to be utilized. They are very often applied to electric light and

power plants, under both the foregoing named conditions; and are also employed for mining purposes, as the mining industry is usually carried on in mountainous countries where high heads frequently occur.

The illustrations, published by permission of Messrs. James Leffel & Co., represent two styles or varieties of this type of wheel, of which the company manufacture more than twenty modifications. The journals or bearings of these wheels are entirely out of water, and outside of the casing, enabling them to be run in oil, and to be inspected at any time.

Fig. 1 exhibits the exterior casing, enclosing the Leffel wheel modified from the ordinary standard make. The principal feature of this duplex combination is its double discharge; the water, dividing equally at the centre and passing laterally and parallel with the shaft in opposite directions, discharges downwards on each side of the wheel through curved pipes, which are attached to draft tubes. The exterior casing is made strong and substantial, but as narrow through the central portion as possible for the purpose of obtaining the shortest distance between the journals, bringing them as near to the wheel as the discharge space will admit, with the object of securing a solid and substantial arrangement in the most condensed form. This style admits of a pulley on each side of the wheel, or on opposite ends of the shaft, or one side only, as the situation requires.

Fig. 2 illustrates the twin combination, consisting of two regularly built James Leffel wheels, placed within a large cylindrical wrought iron casing with cast iron heads. The wheels discharge towards each other, the water uniting and passing downward, through a single draft tube of sufficient capacity for the two wheels. The illustration shows but one pulley attached, but this can be modified to receive two pulleys, one on each end of the shaft similar to Fig. 1, by merely extending the shaft at the opposite end to which the pulley is now secured. These forms also easily admit of attaching the head pipe at any angle from horizontal to perpendicular.

These general styles can be used with, or without, a governor, and may be variously modified to suit any combination of circumstances; but it is necessary for the company to understand the conditions fully, that the best possible adaptation and most harmonious arrangement may be secured.

WORK WITH THE LONG DISTANCE TELEPHONE.

An interesting, well written and appreciative article appeared in the *New York Times* on Oct. 9, describing many of the features connected with the long distance telephone system. It concludes as follows:

"Ithaca and New Haven are now connected, and Mr. A. S. Hibbard has in mind a novel test exhibit for this winter. He will try to have the Cornell and Yale Glee Clubs give simultaneous concerts in Ithaca and New Haven. The two concert halls will be connected by telephone, and then the Yale Club will sing, and both the Ithaca and New Haven audiences will hear the music simultaneously. Then the Cornell Club will sing in Ithaca and the New Haven audiences will hear it as well as the one 400 miles away when the singing is taking place. Spice would be added to the entertainment if a joint debate between the Yale and Cornell navies could be arranged on the Yale-Cornell boating difficulties.

"Mr. Hibbard, at his home in Morristown, received reports by telephone from New London during the last Yale-Harvard race. For the benefit of his guests he rigged up a couple of tin shells, each with its eight oarsmen, and by changing the relative positions of the boats at each report he kept his friends in high excitement for twenty-three minutes. At the end of the race the cheers for Yale from the spectators on the banks of the Thames could be distinctly heard in Morristown."

THE RAE RAILWAY SYSTEM AT NASHVILLE AND CHICAGO.

A contract has just been closed by the Detroit Electrical Works for the full electrical equipment of a street railway in Nashville, Tenn., (Rae system). The Calumet Electric Street Railway, of Chicago, equipped throughout with the Rae system, was successfully opened to the public on Saturday, Oct. 4th. This is Chicago's first electric road and it is received with so much favor that extensions are already being arranged for.

STEVENS' POSITIVE GRAVITY SWITCH.

The accompanying illustrations show the new switch just put on the market by the Electric Merchandise Co., of Chicago. This switch has been christened the "Only" overhead switch. Fig. 1 shows the switch as it appears

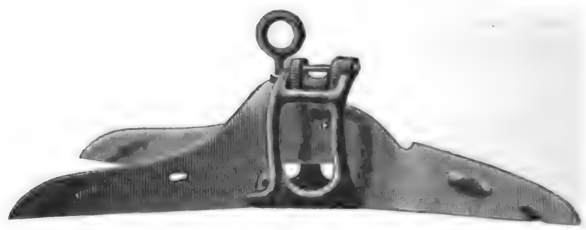


Fig. 1.—The "Only" Positive Gravity Switch.

on the line. It will be noticed that the face of the switch where the trolley wheel runs is level with the trolley wire, having no depressions to wear the wheel. Fig. 2 shows the openings through which the wheel passes. Whichever way the car is going, the wheel itself opens a space wide enough to allow the wheel to pass through. That opening closes immediately as the car passes and is ready for another car or for a car coming in an opposite direction.

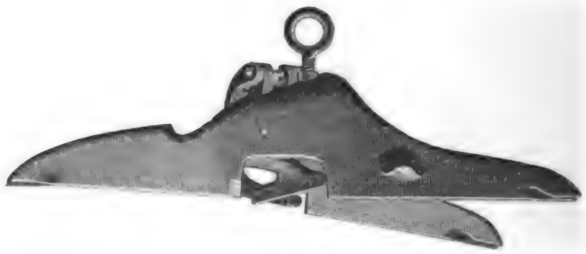


Fig. 2.—The "Only" Positive Gravity Switch.

It matters not at what speed the car is going, it is an impossibility for the wheel to leave the trolley wire. The switch is but 18 inches in length and is said to be by far the smallest overhead switch in the market. It is made for both right and left hand turn-outs.

TO INVESTIGATE GAS AND ELECTRICITY.

State Senator George Z. Erwin has been in New York City for a few days. He is chairman of the committee to which the duty was given of investigating electric and gas lighting. Considerable testimony was taken by the committee last spring. The adjournment of the Legislature prevented the passage of any measures on this subject, but a bill will be presented at the opening of the coming session. The committee will probably meet some time this fall to take further testimony.

COUNTING PRINTED SHEETS BY LAMP FLASHES.

A new use for electricity has been found at the Cook publishing house, according to the Elgin, Ill., *Daily News*. In the office of the superintendent ten electric lamps are arranged in separate compartments of a frame or box, somewhat similar in appearance to the annunciators seen in hotel offices. The lamps are concealed from view, apertures in front of the compartments being covered with colored glass, each having its distinguishing color. The lamps are connected by means of wires with the automatic counting machines on the ten large printing presses located in an adjoining building. When the presses are in operation the circuit is opened and closed by the working of the counting machines, causing quick flashes of light in the lamps. Thus every sheet of paper printed in the establishment telegraphs its record to the office, where the operation of each machine can be seen and its speed, or delays, noted.

In this connection it may be interesting to note that the speed of the large perfecting press is so great that it was found necessary to record each two sheets printed instead of single sheets, and even then the flashes of its lamp are almost continuous in appearance, showing that while the press is not quite as quick as lightning, it is too fast for the eye to follow. It is believed that this is the first application of electricity to purposes of this kind, and it may serve as a valuable hint to managers of large establishments who wish to be enabled to see the operation of their machinery while working at their desks.

SOME OF THE ENGINEERING PROBLEMS CONNECTED WITH THE RE-ESTABLISHMENT OF THE WESTERN UNION TELEGRAPH COMPANY, AFTER ITS RECENT FIRE IN NEW YORK CITY.[1]

BY A. C. ROBBINS.

On the morning of the 18th of July last, occurred the most disastrous fire in the history of the electric telegraph. The General Operating Department of the Western Union Telegraph Co., at New York, was completely destroyed. The general operating room occupied the entire seventh floor of the Western Union Building, with a frontage on Broadway of 75 feet, and on Dey street of 150 feet, and furnishes employment to upwards of one thousand people, operators, clerks and messengers. The height of the room was about 21 feet. A gallery extended across the Broadway end of the room and was occupied by the Commercial News Bureau.

The room contained a main line switch having a capacity of about 700 wires; a city line switch with about 250 wires; a loop switch of 200 loops; 40 sets of quadruplex instruments; 40 sets of duplex instruments; about 700 simplex instruments; the pneumatic tube system; 3 sets of the Hughes-Phelps printing telegraph apparatus; a rapid transit distributing system; and offices of the management and staff.

The battery room was located on the sixth floor, and contained about 20,000 cells, principally of the zinc-copper, gravity form. The coat and toilet rooms were also on this floor.

The eighth floor was occupied by the Associated Press operating department, and the Western Union book-keeping department and the employees' lunch room.

The ninth floor contained the kitchen, and lodging rooms of the lunch room employees. The tenth floor was used as store-rooms for records, and other miscellaneous matter.

The wires entered the building at the cellar, and were 2,000 in number, conveyed to the operating room in cables containing from 50 to 100 wires each, through flues in the central partition wall of the building.

How the fire originated is something of a mystery, and probably will ever remain so. It was discovered by various people on the sixth and seventh floors simultaneously at about 7 o'clock, and spread with such rapidity that several who tarried a few moments in vain endeavor to extinguish it, found the stairways a seething mass of flame, and their only means of escape to be through the windows, from which they were in various ways rescued by gallant firemen, happily without loss of life or accident; as was the case with some half dozen employees who were rescued from the roof by the life-saving corps of the fire department.

While the engines were yet playing upon the building, operators were detailed to Jersey City, Brooklyn, Weehawken, Hoboken, Harlem, and all possibly available suburban offices in all directions, there to tap the wires, and handle the vast business as best they could.

Almost before the fire was entirely extinguished a part of the engineering staff repaired to the former operating-room of the defunct Baltimore and Ohio Telegraph Company, on the fifth floor of No. 415 Broadway, where, with only a room destitute of all furniture, an electric light dynamo in the cellar, and a permit from the authorities to string a few temporary aerial wires, they proceeded to open up communication with the outside world.

Cables were strung to, and connected with, the trunk line cables on the Sixth Avenue Elevated Railway structure, the dynamo in the cellar was put in operation, and at seven o'clock in the evening, after seven hours' labor, they were working their first wires. By Saturday morning they were working 20 wires; and on Saturday evening electric lights, furnished with current from the dynamo in the cellar, replaced the candles and lanterns of the previous night. On Sunday morning a second dynamo for furnishing current of opposite polarity to that of the first one, was in operation, and 12 duplex systems were started. Monday morning found this energetic party operating 15 duplex and 25 simplex circuits to the North, East and South.

The fire occurred on the regular weekly pay-day of the employees, and the systematic and business-like methods of this company is finely illustrated in the fact that every employee who presented his voucher to the cashier on that day received his salary. One employee humorously remarked that while the engines were pouring water into one window he received his money from out another.

The scene inside the building, after the fire, beggars description. It was enough to discourage the stoutest heart. Everything burnable above the fifth floor was entirely consumed. In the operating room, the largest piece of combustible material left was the leg of a table.

The once magnificent switch-board was reduced to a mass of melted brass, and twisted beams, and to trace the identity of a single wire from out the tangled mass would be as difficult as tracing a thread in the broken web of a spider.

Water flowed from the building in rivers, and for days afterward dripped from the ceilings of every floor. This dripping was the source of great annoyance in the work of reconstruction, and in many instances, during the first few days, instruments and wires had to be covered with tarpaulin to protect them from the water.

On the morning succeeding the fire new life was inaugurated amidst the ruins. The fifth and a part of the fourth floors were to be converted temporarily to the uses of the operating department.

The occupants of these rooms were busy removing to other quarters; an army of workmen were engaged in erecting switches, building tables, setting up instruments, and running wires.

The conduit from the cellar was opened in the hall on the fourth floor, and the work of testing out and identifying each one of the 2,000 wires therein was commenced. The pneumatic tubes were opened up in, and business with their terminals conducted from, the cellar.

Day and night the work progressed, until, one by one, as fast as wires were provided, the entire force was brought back. On the following Saturday, eight days after the fire, nearly all of the wrecked wires had been re-connected in working order at the general operating department, and the temporary quarters at 415 Broadway were abandoned.

Gradually the business resumed its former, and well organized routine, until to-day, as for several weeks past, with rude pine benches for desks, and wires strung promiscuously around the ceilings, an unusual delay to a *single* message, and the cause therefor, is instantly known to the management.

One of the worst difficulties encountered in this re-establishment was a lack of proper apparatus, and at times the engineering staff were severely taxed in substituting for apparatus not in stock, and which was needed immediately; for instance, the dynamo duplex and quadruplex systems require pole reversing transmitters different from the ordinary in that they require only two points of contact in place of four where a battery is used.

The dynamo quadruplex system also requires resistances of 600, 900 and 1,200 ohms respectively, in proportioning its currents, and it also requires a set of battery and ground switches of peculiar construction.

Of this apparatus, and much more, only samples are kept in stock, and considerable time is necessary to construct when required. In substituting for the pole reversing transmitters the battery style (of which, fortunately, there was a good supply) was used by the insertion of ivory insulation on two of its contact points. For the quadruplex proportional resistances, incandescent lamps were used until the proper resistance coils could be obtained. While the lamps, as a makeshift, answered fairly well, I cannot say that I consider them a decided success, as they are too sensitive to changes of temperature. The proper equilibrium of the apparatus at the distant station, to a very considerable extent, depends upon the joint resistance of the 900 and 1,200 ohm resistances, equalizing that of the independent 600 ohm resistance; and, again the outgoing current is regulated in proportion as is the 900 to the 1,200 ohm resistance, so that a quadruplex circuit working nicely for a part of the day, is liable to become unsteady, or variable later on by a change in the wind, or draughts of air from an open window, which may cause one set of resistance to vary considerably more than the others. Constant watching, however, partly overcame this difficulty. For 9 point combination dynamo and ground switches, 3 point switches were connected in substitution.

Another difficulty experienced was the want of battery room. No room was available for this purpose, except some shelves in the halls, and boxes under the desks. This was overcome by using the Edison-Lalande caustic soda battery, which, while of low pressure, furnishes quantity sufficient for from 8 to 10 circuits from one battery.

There are 5 local circuits on each set of quadruplex instruments; these circuits ordinarily require 10 cells of gravity battery; 4 cells of the caustic soda battery has been found ample to work the local circuits of 2 sets of quadruplex, a saving of 16 cells, or 80 per cent. in battery room. The same percentage was secured in saving of battery room for the local batteries of the multiplex city loops, several loops being supplied from one battery.

The 20,000 cells of battery used previous to the fire have been replaced by 1,750 cells; and, in a few weeks, perhaps days, not a single cell of chemical battery will be used for telegraph purposes in the general operating department.

For several years past the dynamo has provided current for the main circuits from New York. A potential of 70 volts, regulated by a system of joint resistance, multiple supply, has been applied for supplying the loop locals. For intermediate batteries special apparatus is required for each battery. A one-eighth horse power motor is by current from the building incandescent lamp circuit, run at a speed of about 2,200 revolutions per minute. This motor in its turn operates a generator of equal size and at about the same rate of speed, from which is obtained a current potential of about 100 volts—sufficient for all intermediate battery

1. Paper read before the Electrical Department of the Brooklyn Institute, October 10th, 1890.

purposes. The saving in room is 40 square feet for each intermediate battery. About 50 intermediate batteries were formerly used, but the number will probably be reduced somewhat.

Another question of space was presented when incandescent lamp room was considered. Each battery lead before reaching its wires has a resistance inserted in form of from one to four incandescent lamps for the prevention of damage in cases of accidental short-circuiting. 5,000 of these lamps are necessary for use on the main line switches, and as each lamp requires a space of 3 square inches, or a total of 104 square feet, the problem was an important one.

This was happily solved by placing the lamps on a frame work over the switch. In so doing two results are obtained, viz: Space otherwise useless is utilized; and, secondly, yet of still greater importance, the wire chief is enabled, by watching his lamps to note grounds and crosses on his wires, and by prompt action from such observation prevent destruction by overheating of the instruments in circuit. For the multiplex currents, spaces on the framework of the doors and windows have been utilized, and the lamps thereon serve as monitors for those in charge of the apparatus.

Previous to this arrangement, the burning out of magnets by accidents to heavily charged circuits was a frequent occurrence. Since this improvement, I have yet to hear of the destruction of a single coil in this manner.

The building stood the heat wonderfully well; heat which caused the granite trimmings of the doors and windows to flake and crumble, and glass to melt, had no effect whatever upon the massive walls.

The operating room, which, when first occupied some seventeen years ago, was generally supposed to be adequate to the requirements of the department for all time to come, has for years been entirely too small for the rapidly increasing business.

Particularly during the past five years have these quarters become crowded, and the stern necessity of utilizing every inch of available space been forced upon the management.

Just previous to the fire a prominent official of the department remarked that he did not see how they could work through the coming busy summer season without more room, and that to do so a year hence would certainly be an impossibility. This is only one of many indications of the rapid growth of the telegraph business in recent years. With this experience, it has been decided to rebuild the structure from the fifth floor up, and to extend the building 25 feet on Dey street; and it is confidently predicted that when completed it will be the finest and most complete telegraph office in the world.

The remodelled building will be nine stories high, and the old mansard will be replaced by a flat roof. The sixth floor will be used for offices for various departments; the seventh and eighth floors for operating rooms, and the ninth floor will be occupied by wardrobe and lunch rooms, kitchen, etc.

The operating rooms on the seventh and eighth floors will each have a frontage on Broadway of seventy-five feet, and on Dey street of one hundred and seventy-five feet—considerably more than double the space occupied before the fire, and will be furnished with every facility that can be procured to secure perfection of operation. There will be used twelve dynamos in series of four each for the main line batteries, two only being in use at any one time, and the third series being kept in reserve in case of accident to either of the others. Two dynamos of low voltage will furnish the current for instrument local circuits, one being used and the other held in reserve. Two dynamos will be devoted to supplying current for city multiplex loop, local circuits, one of them as a reserve; and as many sets of the one-eighth horse power motors and generators will be used as there may be intermediate batteries required. The chemical battery will have no place in this model telegraph equipment, its day of usefulness having passed.

To the telegraph engineer it is a pleasing one. It marks an advance of the telegraph, in keeping with the progress of electrical science up to the present time, and we can feel assured that the results will be such as to induce the management to apply the improvements to all the principal offices of the company in the near future.

There is great need of improvements in insulating material. An insulation for wires is needed that will be cheap, light, flexible, and durable; one that dampness will not decay, nor the heat of an electric arc dissolve or burn. A fire extinguishing liquid is also to be desired which will be a non-conductor of electricity. When these have been obtained, and not until then ,can the large telegraph offices be absolutely assured of protection from fire.

Please consider this matter. The one who succeeds in obtaining these results, will, I am sure, be richly rewarded for his trouble. Nearly all of the employees lost personal property in the fire, of greater or less value. Some of the losses were memoranda of experiments never to be repeated, or the gift of some departed friend, and can never be replaced. To some of the employés their losses were, to them, a much more serious matter than was to the company its more formidable calamity; yet from these employees are heard no complaints or lamentations; and, with sad regrets for their misfortune, all turned with eager hands to lend their aid to the restoration of public service.

This disaster has demonstrated that there is to-day between the Western Union Telegraph Company, and its employés in New York City, a combination of capital, labor and harmony. Capital for dividend on its investment; labor for the love of science, and advancement of its chosen profession, and both harmonizing in successful endeavor to make the now largest telegraph office, the most perfect one in the world.

A BRIEF SKETCH OF STORAGE TRACTION DEVELOPMENT.

THE time is certainly ripe for at least a brief review of storage battery traction. It was first attempted at the Paris Exposition of 1881. Two cars were run from the Place de la Concorde to the Palais de l'Industrie. This was shortly after Faure and Julien had begun to introduce the storage battery in Europe. The experiment began and ended there and was resumed in 1883 by Julien, who put a storage battery car in service in Brussels. After a year or so of service, this car was exhibited in service at the Antwerp International Exposition of 1885. It attracted so much notice there and did its work apparently so well, that it was awarded the First Prize as the best and most economical method of street railway traction then known. Succeeding this favorable report, and no doubt actuated by what had been done at Antwerp, The Electric Power Storage Company constructed and put in service one or more storage battery cars at their works at Millwall, England. In the early part of 1885, Mr. Bauer, now of the Pullman Co., made some experiments with a storage battery car in Baltimore with varying degrees of success. In October, 1886, storage battery traction was brought prominently before the attention of engineers in this country by a Julien car which was put in service on 8th avenue, New York city. That car was afterwards transferred to the 4th and Madison avenue line, and was, by degrees, followed up by more cars, until in 1889, the largest installation of storage battery cars that had ever been attempted (to wit, ten in all), was put in actual service on the 4th and Madison avenue line, in New York city. They have continued in service up to the present time with the exception of an intermission brought about by adverse litigation. Following the example of the Julien people in this country, The Electrical Construction Company, Limited, of England, have made an installation of twelve storage battery cars at Birmingham, England. They have built a large station there expressly for storage battery service and Mr. Pritchard, the engineer in charge, reports the road as now in successful operation. Within the last year or so, storage battery traction has been receiving considerable attention in various quarters. Mr. Wharton has now five or six cars in actual service on Lehigh avenue, Philadelphia; that line is run exclusively by the aid of storage batteries. Another company is running four cars at Beverly, Mass., and has been doing so for over a year with considerable success.

The Electric Traction and Manufacturing Company, in New Orleans, have now two storage battery cars in actual service, and have ten additional cars which they expect to have in service by the 1st of November, while a number of additional cars are being constructed for New Orleans.

Two Julien cars are in passenger service at Indianapolis, Indiana; it is said with great success.

A storage battery car equipped by the Daft Electric Company (now the United Electric Traction Company) is and has been for several months past in service in Toledo and with great success. It has carried as many as 1,100 passengers in one day.

One or two cars have for some time been in service on the Metropolitan Street Railway in Washington, D. C.

We understand that four storage battery cars are now in Paris and that arrangements are being made to enlarge the number.

In addition to the twelve storage battery cars in service at Birmingham, there are about eight other cars in service here and there throughout England, so that there are in actual passenger service, 20 cars in England; 10 cars in New York; 4 cars at Beverly, Mass.; 5 cars on Lehigh avenue, Philadelphia; 2 cars in Washington, D. C.; 2 cars at Indianapolis, Indiana; 1 car at Toledo; 4 cars at Paris; 12 cars at New Orleans, and about 6 additional cars here and there on the continent, making in all 66 cars. This would about represent the number of electric cars run by the overhead system sowewhat less than three years ago; the storage battery cars, however, it is claimed, run much better to-day, than the overhead cars did, two and one-half years ago. One of the chief obstacles in the way of storage battery traction has been the uncertainty arising from conflicting litigation as to the ownership of storage battery patents. Considerable allowance for delay must also be attributed to the fact that storage battery traction is more difficult to attain than any other practical system of traction. It has taken longer time, from the very nature of things, to overcome the difficulties encountered in storage battery traction than those to be met with in the overhead system. There now seems to be left but one question as to the final outcome of storage battery traction and its relative position with other systems. That question is its relative economy. The

only element entering into the question of economy is that of the duration of the battery. The battery, as is pretty generally known, is composed of about an equal number of positive and negative plates. The negative plates as now manufactured might last indefinitely. It is fair to say that they will last ten years. It was once thought that they would not last over two or three years. The only question, therefore, is the life of the positive plates. If they can be made to last six months, there is no reason to doubt that storage battery traction is as cheap as horse traction where ten or twenty cars are in service, and cheaper than horse traction, where the number of cars in service exceeds twenty. All the mechanical difficulties heretofore encountered in storage battery traction, have been substantially overcome. They have been overcome as fully as the mechanical difficulties of the overhead system. The car goes and is as reliable in service as a steam car or an overhead car—probably more so. It shifts its batteries in a sufficiently short period of time to admit of that method of traction, no matter what the headway may be on the most crowded line, and by ingenious arrangements the batteries can be shifted economically and can be stored within a small space. The motors, gears and switches are substantially the same as those used by the overhead system, and are, of course, equally reliable. The sole question then is as to the life of the positive plates or one-half the battery. They cost at present for a car about $600; they can be furnished for a much less figure than this when used in large quantities. They ought to last for one year; that would mean $2 a day or two cents a car mile for 100 days' run. They will last longer, running 100 miles a day, than if they should run 50 miles a day. One gratifying point about a storage battery is that the more continuous the service, the better its condition remains. There is nothing more harmful to a storage battery than disuse. Almost all the difficulties encountered on Fourth and Madison avenues, due to the storage batteries, arise, it is stated, on Monday, and are to be attributed to the fact that the batteries have been idle, as the cars do not run on Sundays.

From all that can be learned three cents a car mile for storage batteries is a conservative estimate. This leaves from six to seven cents a car mile for steam power and the maintenance of the motors and gears. Conservative estimates by electrical engineers place the cost of motive power for these items as follows:

Electrical energy delivered at the terminals of the battery or generated on the overhead system	2 cts. a car mile.
Maintenance of motors and gears	2 " " "
Maintenance of batteries	3 " " "
Sundries	1 " " "
Total	8 " " "

or eight cents per car mile by the storage battery system.

Cost of motive power in horse traction in large cities is 10 cents per car mile; leaving in favor of storage battery traction two cents per car mile. Add to this the superior service obtained, and the advantages are unquestioned.

ELECTRIC RAILROADING AT NEWARK, N. J.

Newark, N. J., celebrated on Saturday Oct. 4th, the opening of the first electric road operated within the corporate limits of the city. It is called the Market Street and Springfield Avenue Road, runs through the most crowded district, and is of the overhead single-trolley type. The equipment consists of twenty eight-wheel cars, each 32 feet long, which are driven by two 20 h. p. Thomson-Houston motors. The current is generated by Thomson-Houston dynamos, driven by Straight-Line compound tandem engines of 500 h. p. The complete installation was made by the Field Engineering Company, of this city.

All day the cars were loaded to their full capacity and ran without a delay of any kind, although the line has a number of heavy grades. The system is to be extended to nearly all the lines in the city, and the Field Engineering Company is now prepared to erect a 4,000 h. p. central station. It selected the location last week.

ELECTRIC RAILROADS AT ROCK ISLAND, ILL.

The Tri-cities—Rock Island, Moline and Davenport—will soon have a complete electric railway system in operation. The Thomson-Houston Electric Company, of Boston, through Mr. F. W. Horne, who represents its railway department, has, as lately noted in these columns, closed a contract with Mr. C. B. Holmes, John J. Mitchell and E. Buckingham and the Davenport & Rock Island Railway Company for the construction and equipment of such an electric railway. The contract represents the sum of $350,000. There will be twenty miles of single track and five miles of double track, containing more than sixty curves; and 2,100 feet of track will be on bridges, including 1,500 over the government bridge. The overhead system will be employed and the wires will be carried over the bridges on towers. The contract calls for fifty passenger cars, seven 100 h. p. generators, two 350 h. p. Corliss engines and three 300 h. p. Hazelton boilers. It is expected that the whole will be completed in something less than 80 days.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.

Anonymous communications cannot be noticed.

The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.

In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.

Sketches and drawings for illustrations should be on separate pieces of paper.

All communications should be addressed EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

A CURIOUS BREAK IN A CONVERTER PRIMARY.

[141.]—I would call the attention of your readers to a sample of wire taken from the primary coil of a converter, which shows an apparently unaccountable break. The ends of the break are fused, while the insulation has not been charred except close to the break. There was nothing to show that this was caused by any cross with the secondary coil, or by any escape to ground. It is accepted by some people as being a freak of lightning, and has come to be such a common occurrence as to amount to a very serious trouble. I would like to inquire whether others have noticed this difficulty and whether there is any good explanation to give except a fault in the copper finally resulting in a break.

C. W.

CHICAGO, Ill., Sept. 27, 1890.

OFFICIAL REPORT ON THE KEMMLER EXECUTION.

Dr. Carlos F. Macdonald, president of the State Commission in Lunacy, has furnished Governor Hill an official account of the recent death of William Kemmler at Auburn Penitentiary by electricity. He admits the bungling, torture, and uncertainty and says in contradictory conclusion:

Compared with hanging, in which death is frequently produced by strangulation, with every indication of conscious suffering for an appreciable time on the part of the victim, execution by electricity is infinitely preferable, both as regards the suddenness with which death is effected and the expedition with which all the immediate preliminary details may be arranged. By the latter method the fatal stroke renders its victim unconscious in an infinitesimal fraction of a second, so small as to be beyond the power of the human mind to estimate, while, at the same time, it disintegrates the nerve tissues and blood to an extent which insures an absoluteness of death in a shorter space of time than is possible by any other known method. In other words, it is the surest, quickest, most efficient and least painful method that has yet been devised.

The execution of Kemmler, from the time he entered the room until the second contact was interrupted, occupied not more than eight minutes; whereas executions by hanging usually require from fifteen to thirty minutes. In fact, it not unfrequently happens that the heart continues to beat for that length of time after the fall of the fatal drop. Then, too, far more time is consumed in placing the prisoner on the gallows, pinioning his limbs, putting on the black cap, placing the noose about his neck and carefully adjusting the knot under his left ear (from whence it sometimes slips at the critical moment, resulting in strangulation instead of a broken neck), than would be required for arranging the preliminary details of an electrical execution. During the preparation of this report the Associated Press dispatches contained an account of a hanging in which the criminal's head was almost completely torn from the body.

Dr. Macdonald makes the following recommendations:

First.—The statute providing for the execution of criminals by electricity should be amended so as to provide for but one plant, to be located in the central part of the State, in a building especially constructed for the purpose. The building should contain the necessary electrical apparatus, an engine, execution-room, solitary cells and quarters for the guards and other necessary officials, the apparatus to be in charge of and operated by a competent, accredited electrician.

Second.—The engine and dynamo should be especially constructed for the purpose, and should be capable of generating an electromotive force of at least 3,000 volts, in order to insure the maximum voltage that would be necessary and at the same time cause no injustice to any electrical lighting company, such as is likely to be the case so long as commercial dynamos are used in executing criminals.

Third.—The volt-meter should be located in the execution-room, and a competent and responsible official should be detailed to take the readings of the meter before and at the instant the current is applied. The voltage should not be less than 1,500, nor more than 2,000, and should be a matter of official record. The prisoner's resistance should also be taken immediately before bringing him into the execution-room.

Fourth.—The statute should require an official report of each execution to be made to the Governor within ten days after the execution takes place.

EUROPEAN CORRESPONDENCE.

LONDON.

London and Manchester Connected by Telephone.—The Postmaster-General's Report.—The Vaughan-Sherrin Battery.—Church and Telephony.—Electric Light at Godalming.—Another Elmore Copper Company.

COMMUNICATION by telephone has just been opened by the National Telephone Company between London and Manchester. The route is via Macclesfield, Birmingham and Coventry, the distance being 219 miles. The line was used on Monday night for the first time at a semi-private gathering by members of the Manchester Field Naturalists Society, who conversed with Prof. Meldola, F. R .S., Sir Philip Magnus and others, of London. The wire employed, 11½ B. W. G., is of hard drawn copper, 200 lbs .to the mile, and has cost £13,000. Blake's transmitters as used in ordinary exchange work were employed, and the Bell receiver. The voices were distinctly heard in London and easily recognizable. Connection was afterwards made with the Savoy Theatre, London, when the music of the Gondoliers was heard over the wires with great effect.

The Postmaster-General's report shows a remarkable increase in the year's telegraphic business. During the twelve months 62,408,399 telegrams were sent over the wires, which is several millions above the previous year's figures. In the period under review, 263 post offices and 58 railway offices were opened for telegraphic business, making a total number of 5,673 offices. On September 2nd, 1889, the issue of telegraphic money orders between London and 17 large towns was begun as an experiment. Between that date and Feb. 28, 2,088 orders of the value of £8,674 1s. 3d were issued, and on March 1, the system was extended to all head and branch post-offices in the United Kingdom, with the result that in one week 573 telegraphic orders were issued, representing a sum of £1,968. In the month 1,769 orders were issued, amounting to £6,262.

A company has been formed to acquire the patents of the Vaughan-Sherrin which consists of a special kind of primary battery and motor. Tests were made yesterday of their motive power in combination with a tricycle, bath chair, and electric launches. The battery is a two fluid one with sheet zinc and carbon. In each cell there are three fixed carbons and two replaceable zincs. The outer cells are made of gutta percha and in them are placed the porous cells which surround the zincs. The liquid used in the inner cells is water, whilst that placed in the outer cells is a depolarizing liquid of special composition, supposed to be produced at a low figure. The E. M. F. is nearly two volts. The motor is a two pole Gramme machine with the field magnets arranged in a peculiar way. Prof. Silvanus P. Thompson has tested the battery and concludes his report as follows:

"Considering the size and weight of the motor, and comparing its efficiency with that of the best motors of equal weight or power in the best motor in the market, I consider the performance of Mr. Sherrin's motor very satisfactory. For so small a motor the power is high, being at the rate of one horse-power for only 62 lbs. of dead weight. The electrically-propelled bath chair is fitted with a small motor and driven by current from ten of his cells. In a short run which I took in it on unfavorable roads, it ran about six miles per hour on the level. It was perfectly easy to manage, and the batteries gave no trouble either from spilling or fuming. I consider the electrical chair a thoroughly practical and successful vehicle."

The cost of current is estimated by the Professor at from *9d.* to *10d.* per Board of Trade Unit. It is claimed that the tricycle will travel at eight miles an hour.

The experiments of connecting telephones to Christ Church, Birmingham, which I mentioned would take place, was a distinct success. When the morning service began there was quite a clamor to be put in connection. The morning prayer was interrupted by irreverent cries of "Hallo there," "Are you there," "No, I don't want the church." These and other interruptions drowned for a time the voice of the minister, but when quiet was obtained, there was an unbroken connection which allowed of the service being heard.

Connection was also made with London, Manchester and other large towns, the service being heard with ease.

The electric light committee of Godalming, after visiting the electric light works at Bath, recommended the adoption of electricity for public and private lighting. As the committee is practically the Town Council, it is probable that work may be expected shortly.

Another Elmore Copper Company has been added to the list under the title of the Elmore Austria-Hungary Patent Copper Depositing Co. It will acquire the patents for operating in that country for £50,000 in cash, £50,000 in shares and the premium of 10 s. each on 75,000 shares, making a possible purchase price of £137,500. It is a curious thing how anything relating to Elmore is snapped up by the British public, although not a single definite figure is given as to work done. H. S.

LONDON, Oct. 1st, 1890.

CORRESPONDENCE.

CHICAGO.

Calumet Electric Road Opened.

THE Calumet Electric Street Railway, the first in Chicago to adopt electricity as the motive power, was formally opened to the public last week.

At 3.30 p. m. a car left the northern end of the line, carrying on board C. E. Loss, the contractor; Columbus R. Cummings, N. K. Fairbank, S. E. Gross, W. V. Jacobs, the representatives of the press and a few others. After a lunch at the power house and a short speech by Mr. Loss, the party returned to the city. Many were the expressions of satisfaction at the smoothness of the road-bed, the comfort and elegance of the car, and the high speed attained.

The new line is only the commencement of an extensive system to connect the various manufacturing and residence suburbs which now lack proper communication with each other. It extends at present from the South Chicago Rolling Mills by way of 89th street, Mackinaw avenue, Harbor avenue, 93rd street and Long Island avenue, to 95th street. The Rae system of electric traction is employed, overhead construction being used, and each car is equipped with a single motor, and the cars are very strongly built and with their equipment weigh about 5 tons each, and attain a speed of from 15 to 20 miles with perfect ease and safety. The curves and switches are guarded against accident by an automatic device, of which Mr. Loss is the inventor.

The power house is equipped in the most complete manner with Armington-Sims engines of 125 horse-power, boilers, etc., and the power plant was constructed by the well known Pond Engineering Co., who have an enviable reputation for the excellence of their work. The present power capacity is capable of supplying the line opened last week, and another already built from Pullman to Cottage Grove avenue and 87th street. By December 1, a connecting line will be opened from South Chicago to the Pullman line at Cottage Grove avenue and 104th street. As soon as practicable, the system will be extended to 115th street, through 115th street, Michigan avenue, 111th street and Vincennes Road around Washington Heights and Morgan Park. Further extensions will probably follow.

Mr. S. S. Breman is now engaged in getting out plans for a two-story repair shop 500 feet square at an estimated cost of $250,000, to be built at Pullman for the Pullman Palace Car Co. It will accommodate 100 cars at a time, and have electric light, steam heat and all the latest improvements.

N. E. Swartout, of Chicago, foreman of the Postal Telegraph Company, is busily engaged at Terre Haute, Ind., in securing a right of way through that city for the projected extension of his line from Indianapolis to St. Louis. The company has secured the right of way on the National road and through all other cities along the route. The new line will be in working order by the first of the year.

CHICAGO, Oct. 9, 1890.

BOSTON.

West End Railway Work.—The Portelectric System.

MAYOR HART has received and transmitted a petition from the West End Street Railway Company to the Board of Street Commissioners, begging the city to extend Harrison avenue of its present width to Avon street, and from Avon street to Summer street, on lines to connect with Hawley street; also to extend Hawley street of its present width to Water street and to widen Water street by including therein that portion of Spring Lane and the buildings situated between Spring Lane, Water street and Devonshire street, easterly of said proposed extension of Hawley street.

The West End Company are continuing the good work of laying substantial T rails, and have this week completed a most important improvement at the corner of Boylston and Tremont streets, the entire location of the tracks and curves having been changed and relaid.

The New England Portelectric Company are making excellent progress with their demonstrative section at Dorchester, and have given several exhibitions of the working of the system. They do not claim that these exhibitions are to show the speed that can be developed, but merely to demonstrate to the doubting that progress is being made in the right direction. As the principle involved is absolutely new, an immense amount of purely new experimental work has to be done, and improvements are being made every day. The track is 2,784 feet long, and coils about 11 inches in diameter and nine inches broad, are set along the whole length of the track at intervals of six feet. The car is cigar shaped, pointed at both ends, measures 12 feet in length and is 10 inches in diameter, weighing 350 pounds. Severe grades and curves have been introduced in the track, the worst being a 5% grade on a 280 feet radius curve. The best speed that has yet been developed has been 1½ minutes for the whole course, but this does not represent in any way the ultimate speed when the

system is perfected, merely showing that the scheme is feasible, and possesses great possibilities of success. Mr. Williams, the inventor, is perfectly confident that he will be able to treble or quadruple this speed when he gets the electrical details thoroughly perfected. At present the system is using about 200 volts and an average of 30 amperes, though owing to the construction of the truck and rails, one of the rails being a conductor, there is a great amount of breakage and consequently lost energy.

BOSTON, MASS., Oct. 11, 1890.

REPORTS OF COMPANIES.

ANNUAL REPORT OF THE WESTERN UNION TELEGRAPH COMPANY.

Net earnings amounting to $7,312,725 were shown in the report for the fiscal year 1890 submitted at the annual meeting of the stockholders of the Western Union Telegraph Company yesterday. This is an increase of more than one million dollars over the net earnings of the previous year. After paying interest and dividends, the Western Union will have a surplus, according to the Treasurer's report, of $1,441,582. The aggregate dividends paid for the year amounted to $4,956,000.

In President Green's report to the stockholders he shows that the capital stock of the Western Union now amounts to $86,199,852, of which $26,243.93 is in the company's treasury. The bonded indebtedness of the company is $14,779,500. Of the increased earnings the land lines yielded $1,362,925 and the cable lines $240,000. There was about $43,000 increase in the amount realized from leased wires. The figures show that the company now has a total surplus of $10,052,900.

In the course of the year 55,878,762 messages were sent over 678,997 miles of wire on 183,915 miles of poles. The average toll per message was 32.4 cents, against 31.2 cents in the previous year. No increase in the message rates has been made anywhere, and Dr. Green says that the increased rate per message is attributable to the fact that the greater part of the increased business consisted of long distance messages, which paid the highest rates.

The expenses of the company for the year were as follows: Operating and general expenses, $10,863,063; rentals of leased lines, $1,637,125; maintenance and reconstruction of lines, $1,988,652; taxes, $310,297; equipment of offices and wires, $275,164; total expenses, $15,074,803. The report says:

"The additions to plant during the year were 5,163 miles of line and cables, 31,300 miles of wire, and 912 new offices, at a cost of $1,778,314, paid for out of the surplus earnings. There was expended for the purchase of stock of telegraph companies $138,868, making the total cash expenditure for new property $1,917,182. It has been the effort of the management to keep the expenditure for new property down to about $1,000,000 per year, but the cost of the ocean cables, each about 850 miles long, has swelled the account this year. There has been expended in cash out of surplus earnings for new property since July, 1866, $27,653,357; in 24 years the expenditures have been $65,181,357. Of the $27,653,357 cash investments in new property $15,526,590 was capitalized in 1881, and $1,200,000 in 1887, leaving nearly $11,000,000 of surplus earnings invested in the property and not capitalized."

Of the securities owned by the Western Union Company there is an increase of $1,943,800 in the Gold and Stock Telegraph Company, about $1,750,000 in the Inter-Ocean Telegraph, and $1,000,000 in the Metropolitan Telephone Company.

The old Board of Directors was re-elected, with the exception that Charles F. Mayer, President of the Baltimore & Ohio Railroad, was chosen to succeed John Jacob Astor.

WANAMAKER ON WESTERN UNION FINANCES.

Postmaster-General Wanamaker has written a letter to Gen. H. H. Bingham, chairman of the House Committee on Post Offices and Post Roads, renewing his advocacy of the limited postal telegraph scheme. In the course of it, he says: "According to uncontroverted statements made before your honorable committee, the capital stock of the Western Union Telegraph Company in 1858 was $358,700. The stock dividends declared between 1858 and 1866 amounted to $17,810,146, and the stock issued for new lines was $1,937,950; so that the capital stock on July 1, 1886, was $20,133,800. In 1866 new stock was created to the amount of $20,450,500, so that the total capital of the Western Union on July 1, 1867, was $40,568,300. The largest dividend declared by the company up to 1874 was 414 per cent. The largest amount of stock ever divided at one time was $10,000,000, and for a period of seven years the dividends were about 100 per cent. a year on its average capital. It was by adding dividends to dividends and by piling the one up on top of the other that this tremendous amount of $40,000,000 of capital and debt was created. The history of the company shows no change of policy. In 1874, the company bought up its own stock and the stock of other telegraph companies, and accumulated a fund of over $15,000,000, which was held in one shape or another in the treasury of the company. An investment of $1,000, in 1858, in Western Union stock would have received up to the present time stock dividends of more than $50,000, and cash dividends equal to $100,000 or 300 per cent. of dividends a year. These have been some of the dividends declared: In 1862, 27 per cent; 1863, 100 per cent; in 1864, 100 per cent; in 1878, $6,000,000; in 1881, one of $15,000,000 and another of $4,300,000; in 1886, 25 per cent. The Western Union plant, exclusive of its contracts with railroads, could be duplicated for $35,000,000. Its present capital is $86,000,000. It has realized $100,000,000 of net profits in twenty-five years by its high charges."

INCREASE OF CAPITAL.

THE SOUTHERN ELECTRIC SUPPLY COMPANY, St. Louis, filed statement of increase of capital from $10,000 to $25,000.

HEAVY SUBSCRIPTIONS FOR THOMSON-HOUSTON STOCK.

The subscriptions to the 10,000 shares of the new stock to be held by the Thomson-Houston common stockholders closed last week. They aggregated 33,500 shares, or more than three times the issue. The subscribers will be awarded 30 per cent. of their bids.

STOCKS AND BONDS.

HALIFAX, N. S.—A Halifax dispatch says: A trust deed has just been registered in the register of deed's office, of this city, in which the Halifax Illuminating and Motor Company, Ltd., which a short time ago took over the street railway, have transferred to the Suffolk Trust Company, of Boston, all the real and personal estate of the company, with appurtenances thereto belonging, in trust for the equal pro rata benefit of shareholders for $300,000, debentures of the company being issued therefor in the sum of $500 each. The mortgage previously held by the Suffolk Company has been paid off.

A SIMPLE DESCRIPTION OF ARC AND INCANDESCENT LAMPS.

Sir David Salomons contributes to the October *Lippincott's* an interesting treatise on "Electric Lighting," from which we extract the following very simple and lucid popular description of the two forms of the electric light:—

In the arc lamp the current passes through two carbon rods, which are separated from each other by a very short distance. In order that the current shall leap this interval, the rods are made to touch each other, and then they are separated; a flame, consisting of heated gases, passes between these carbon rods, which flame must not be mistaken for visible electricity. The powerful light is produced by the intense heat to which the ends of the rods are raised. Suitable apparatus is connected with these carbons, in order that they may be fed as they burn away. Otherwise the distance between them will increase, and eventually the current will cease to flow. This form of light is termed "arc" light, because the flame resembles in shape an arc or a crescent.

The incandescent or glow lamp consists of a very fine filament of carbon, hermetically sealed in a glass globe from which the air has been exhausted. The ends of the filament reach the outside of this globe by being attached within in it to two platinum wires which pass through the glass to the outside, where they are dealt with in some convenient way whereby they may be attached to the circuit. The current consequently enters the filament at one end and leaves it by the other. The filament becomes white hot during the time that the current passes through it, and is not consumed, since it is not in the presence of air. The high resistance of the carbon filament necessitates a great loss of pressure in the current during its passage, and is converted into light-giving heat. If the pressure of the current is greater than that for which the lamp was constructed, too much current will pass through the filament, and it will be destroyed. On the other hand, if the pressure is insufficient, the temperature to which the filament ought to be raised will not be reached, and the light will be far less than it should be under normal conditions. The light given by any lamp diminishes in far greater proportion than the equivalent fall in the pressure of the current; and the inverse is true. For instance, a lamp intended to give a certain light with a given pressure of current would give less than half its light with a fall of 10 per cent. in pressure. On the other hand, a four per cent. increase of pressure above the normal would produce at least double the light intended.

FINANCIAL MARKET.

QUOTATIONS ON ELECTRICAL STOCKS.

Mr. F. Z. Maguire, Electrical Securities, of 18 Wall street, this city, reports the following quotations of October 11th, from New York, Boston and Washington :

NEW YORK.

	BID.		BID.
W. U. Tel. Co...............	81⅞	Edison Gen. Elec. Co......	26¼
American Tele. & Cable...	83	Edison Gen. Co. Def'd.....	86
Centl. & So. Amer..........	155*	Consol'd Elec. Lt. Co.......	...
Mexican.....	205*	Edison Illn'g Co. N. Y.....	70
Com. Cable Co.............	102	U. S. Elec. Lt. Co...........	30
Postal Tel. Cable...........	39	North Am. Phonograph....	....

*Ex. Dividend.

BOSTON.

	BID.		BID.
Thomson-Houston..........	51¼	Ft. Wayne Co...............	11¼
" Pref'd.....	26⅜	Am. Bell.....................	220
" Series C.....	11⅜	Erie...........................	48
" " D.....	6	New England................	51½
" Int. Co.....	....	Mexican......................	.80 cts
Thomson Welding Co......	185	Trop. American.............	..
Thomson Eu. Welding......	72	Edison Phon'gph Doll.....	1½

WASHINGTON.

	BID.		BID.
Penna. Telephone..........	26	U. S. Elec. Lt (Wash).....	151
Ches. & Pot. Telephone.....	70	Eck.&Sold. Home Elec. Ry.	65½
Amer. Graphophone.......	14⅛*	Georgetown & Tenallytown	

*Ex. Dividend.

PITTSBURGH.

	BID.
Westinghouse Electric and Manufacturing Co......................	30

OBITUARY—WILLIAM SPRAGUE.

It is with regret that we have to announce this week the untimely death, by his own hand, of Mr. William Sprague, at Seattle, Washington. Mr. Sprague was well known in electrical circles in Chicago, to which city he went from Washington, D. C., and joined the forces of the Great Western Electric Supply with the intention of working his way to the front of the profession as an electrical engineer. He subsequently left the Great Western Company and was engaged upon underground electrical work in Chicago, and about three weeks ago accepted an advantageous position on the Seattle *Journal*, in Seattle, Wash. Mr. Sprague, who was the son of ex-Governor Sprague, of Rhode Island, and grandson of Chief-Justice Chase, was a bright and well educated young man, and would undoubtedly have made a brilliant success in the electrical profession. His remains will be taken to Providence and buried in Swan Point Cemetery there.

DEATH OF DR. EMIL STOHRER.

The death is announced of Dr. Emil Stöhrer, the inventor of numerous appliances in telegraphy. Among them was a dial telegraph operated by alternating magneto-electric current devised in 1846, and a two-point register (1850) which printed two lines of dots and dashes, partly chemically and partly mechanically.

LEGAL NOTES.

THE TELPHERAGE INTERFERENCE—HUNTER VS. JENKIN.

The Board of Appeals of the U. S. Patent Office has decided the interference case of R. M. Hunter vs. Fleeming Jenkin in favor of Jenkin. The late Prof. Fleeming Jenken, who coined the word "Telpherage," obtained a British patent in 1882 and a U. S. patent in 1884. Hunter filed an application in 1886—about twenty months after the issue of the Jenkin patent—which was put into interference with that patent.

The Board of Appeals holds that, even if Hunter conceived the invention in 1879, as he alleged, he had forfeited his rights by laches. The decision is of general interest because of the invention involved, and also because of its important bearing upon the vested rights of patentees. In another interference between Hunter and Miller on somewhat the same subject, the decision of the Commissioner was in favor of Hunter, though Miller had a patent, the application for which, however, was pending concurrently with the application of Hunter. Hunter's proof in both cases was the same ; but in the Jenkin interference lack of diligence was the ground upon which the Board based its decision against him.

SOCIETY AND CLUB NOTES.

THE AMERICAN STREET RAILWAY ASSOCIATION.

The Association will, in accordance with announcement, meet at Buffalo on Oct. 15, the Hotel Iroquois being headquarters. A large attendance is expected, and electricity promises to be the leading topic.

THE TELEGRAPHERS' BALL.

The telegraphers of this city will give their annual ball on Oct. 15. One of the events of the evening will be the presentation to Miss Kittie B. Stephenson, of a handsome cairngorm brooch from the Hon. James D. Reid, as a special prize, Miss Stephenson having been the first lady winner in the fast-sending tournament at Hardman Hall.

WHAT IS SAID OF "THE ELECTRICAL ENGINEER."

THE ELECTRICAL ENGINEER, which has recently appeared as a weekly publication of 50 to 60 pages from the office, 150 Broadway, is the oldest electrical journal published in the country. It is now probably the leading technical electrical periodical of America.—*N. Y. Daily News.*

No more authoritative or better conducted journal for electricians is published in this country than THE ELECTRICAL ENGINEER. By its weekly visits is assured thorough and masterly instruction regarding all improvements and advancements in electrical science and associated topics.—*Troy Times.*

THE BAXTER MOTOR FOR ELECTRIC RAILWAYS.

The electric street railway people and in fact all street railway companies about changing to electric power will be interested in the new slow-speed motor being brought out by the Baxter Electric Motor Co., of Baltimore. The armature speed is only 42 turns per mile per hour—*i. e.*, with a car going at the rate of five miles per hour, 210 turns per minute—eight miles, 336 turns per minute, etc. The performance of this new motor will be looked forward to with interest.

INVENTORS' RECORD.

Patents issued October 7.

Alarms and Signals:—*Electric Guest-Call*, G. P. Ransom, 437,798. *Electrical Transmitter and Indicator*, D. Keley and M. C. Parkhurst, 437,859. *Combination Lock and Alarm*, R. Bauman, 438,049. *Burglar Alarm*, W. J. Ackerman, 438,127.

Conductors, Conduits and Insulators:—*Insulator*, T. F. Gaynor, 437,685. *Covering for Electric Wires*, D. Brooks, Jr., 437,918. *Aerial Conduit for Electrical Conductors*, A. A. Knudson, 438,003. *Pole for Electric Wires*, E. Verstraete, 438,086.

Dynamos and Motors:—*Regulator for Electric Generators and Motors*, R. Lundell, 437,704. *Electric Motor*, J. Emmner, Jr., 437,832. *Electric Motor*, G. Little and G. J. Little, 437,835. *Commutator*, H. H. Blades, 437,844. *Brush-Holder for Electric Motors*, E. A. Sweet, 437,946.

Lamps and Appurtenances:—*Arc Lamp*, R. H. Beach, 437,767. *Electric Light Fixture*, J. E. Brown, 437,851. *Pulley Attachment for Electric Lamps*, T. H. Brady, 437,883. *Electric Arc Lamp*, C. W. Hazeltine, 437,901. *Terminal Switch or Cut-Out for Electric Lighting Systems*, W. F. Smith, 438,118.

Measurement:—*Electric Meter*, J. Einstein and S. Kornprobst, 437,754. *Electric Meter*, A. Reckenzaun, 437,763. *Galvanometer*, T. Harris, 437,926.

Miscellaneous:—*Electric Valve-Controller*, L. Bell and F. H. Roat, 437,673. *Electric Safe-Lock*, G. L. Damon, 437,682. *Electric Steam-Generator and Water-Heater*, H. R. Butterfield, 437,771. *Electric Ceiling-Block*, A. E. Nichols, 437,789. *Electric Advertising-Clock*, M. Levi, 437,905. *Automatic Passenger Register*, A. Gajardo, 437,985. *Rheostat*, J. C. Velter, 438,087. *Metal and Circuit Detector*, R. L. Watkins, 438,041.

Railways and Appliances:—*Conduit Electric Railway*, E. M. Reed, 437,720. *Conduit and Electric-Conducting-Rail therefor*, 437,953. *Trolley*, I. F. Baker, 437,961. *Railway Train-Signal*, D. S. McElroy, 438,084.

Secondary Batteries:—*Secondary Battery*, H. Lampert, Jr., 437,848. *Electrode for Secondary Batteries*, W. Shapleigh, 438,116.

Telegraphs:—*Receiving Instrument for Telegraphy*, W. M. Miner, 437,990.

Telephones and Apparatus:—*Telephone Support*, F. C. Hughes, 437,927. *Telephone System*, A. Graham, 437,986.

ALTERNATING VERSUS CONTINUOUS CURRENTS IN RELATION TO THE HUMAN BODY.[1]

BY H. NEWMAN LAWRENCE, M. I. E. E., AND ARTHUR HARRIES, M. D.

THE present paper is supplementary to a preliminary paper on the same subject read before the Institute of Electrical Engineers on the 27th of March, 1890.

In that paper it was stated (page 1, Soc. J., Vol. 86, 1890) that "our experiments have not been made with the powerful currents dealt with in electric lighting and distribution of power," and this admission, together with the difficulties inseparable from the accurate measurement of alternating coil currents, are points in connection with our paper which have given rise to much discussion in the electrical and other journals.

In the present instance, however, we have endeavored as far as possible to obviate criticism on these grounds.

1. By using currents directly from lighting circuits—both alternating and continuous.

2. By using currents directly from a dynamo whose rate of alternation could be accurately ascertained.

3. By using currents of high E. M. F.

4. By using an instrument for the measurement of alternating currents, whose accuracy at the reading of our former paper was theoretically questioned by one or two speakers, but which has since been tested and proved to give correct readings by an eminent practical electrician, thus confirming the accuracy of the readings formerly recorded by the instrument, as well as those which are contained in our present paper.

Another practical point to which special attention has been given in this paper is that our experiments have been made chiefly with the skin in a state of nature, so that the conditions of experiment as nearly as possible resemble those which might be expected to exist under accidental circumstances, that is to say, under circumstances when contact with the conductors was unexpected and therefore unprovided for.

The following are the conclusions arrived at:

A. When the human body, with the skin in its normal unmoistened condition, comes into contact for an appreciable time with bare metal conductors of a dynamo-generated continuous current passing at about 100 volts in such a way that the current passes from hand to hand, and the total contact area is about 90 square centimetres,—

1. A current of about 0.016 ampere will pass through it.

2. This current can be borne without discomfort for 15 to 30 seconds.

3. After about 30 seconds unpleasant burning sensations become marked and quickly increase.

4. The subject is perfectly able to release himself at will during any portion of the time of contact.

B. When the human body comes into contact with dynamo-generated alternating currents, alternating at about 60 to 70 per second under the same conditions as above,—

1. A current of about 0.025 ampere will pass through it.

2. This current is *six times greater* than that which produces discomfort.

3. Instantly the subject is fixed by violent muscular contraction and suffers great pain.

4. The subject is utterly unable to release himself, but remains exposed to the full rigor of all the current that may be passing.

C. When circuit from electric light or power conductors is accidentally completed through the human body, the danger of serious consequences is many times greater when alternating than when continuous currents are passing at equal voltage, and this is still to a large extent true if the voltage of the continuous current be double that of the alternating.

1. With both forms of current a reduction of contact area materially reduces the amount of current strength that passes.

2. With the alternating current, if the rate of alternation be reduced below 50 per second, the sensations of pain accompanying muscular fixation will be increased, while if the rate of alternation be increased, the pain will be diminished.

Finally, we would remind those gentlemen who so commonly speak as if voltage were the chief or only factor in the danger of accidental contact, that *current strength is the important item*, and that, according to Ohm's law, current strength is dependent not only upon E. M. F., but upon the total resistance in circuit at the time of accidental contact.

To make statements based upon voltage only, such as newspaper reports of a recent execution have contained, is not only distinctly misleading, but calculated to induce the uninitiated to form erroneous conclusions.

1. Abstract of a paper read before the British Association meeting, Leeds, September, 1890.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

ELECTRIC LIGHTING IN BALTIMORE.

The Brush Electric Company, of Baltimore, Md., is now making improvements and additions to its already very extensive alternating current electric lighting plant, which will give it a total capacity of twenty thousand 16 c. p. lamps; and thereby the Baltimore central station plant will become one of the largest alternating current incandescent lighting plants in the United States. This fact does not only reflect very creditably upon the population of Baltimore for appreciating the advantages offered by electrical illumination generally; but it also proves the rapid growth of the popularity of the alternating current system of incandescent electric lighting.

It was in the early part of 1887, a little over three years ago, that the Brush Company made the first contract with the Westinghouse Electric Company for the installation of alternating current apparatus aggregating a capacity of 5,000 lights. The undertaking was then looked upon as more of an experimental test of the new Westinghouse system than anything else. The Baltimore company had been frequently urged to extend its system of lighting all over the city, but the management had not been able to comply with this demand because the electric lighting system in operation would not enable them to cover any large territory without the putting up of several additional power houses. In other words, it was not suitable for long distance lighting. But as the Westinghouse Company claimed for its alternating current system that it was especially adapted to cover a large area in a safe and yet economical manner, it was thought advisable to try it. This was done, and it is only just to remark that from the very moment the wiring was completed, the apparatus put up and the current turned on, the Westinghouse alternating current system proved an unqualified success.

From that time the popularity of the new system was in Baltimore an established fact. The demand for the new light grew at an enormous rate, and before long the company was compelled to increase its plant. The Westinghouse Company was called on for additional apparatus of three thousand lights capacity. But even this did not long satisfy the demand, and twice again the company increased its capacity by three thousand lights, until at the beginning of the present year, the central station plant of the Brush Electric Company, of Baltimore city, had a total capacity of fourteen thousand alternating current incandescent lights

This last addition has again been necessitated on account of the demand which has been made on the Baltimore plant, and when the installation shall have been completed, there will be but two cities in the country with larger capacities of alternating current incandescent lighting apparatus—Pittsburgh, with sixty thousand lights, and New York, with fifty thousand.

WOODBRIDGE & TURNER.

This enterprising and successful firm of electric railway engineers and contractors, 74 Cortlandt street, find themselves very busy at this season and are increasing their force and enlarging their office. The following is a list of roads they have built and equipped: Augusta Street Railway, Augusta, Ga., 16 miles, 10 cars; Brooklyn and Jamaica Railway, Brooklyn, N. Y., 10 miles, 6 cars; Chattanooga Electric Street Railroad, Chattanooga, Tenn., 6 miles, 6 cars; Chattanooga Electric Street Railroad, Mission Ridge Extension, Chattanooga, Tenn., 1 mile, 2 cars; Chattanooga Electric Street Railroad, St. Elmo Line, Chattanooga, Tenn., 5 miles, 3 cars; East Reading Railroad, Reading, Pa., 1¼ miles, 2 cars; Hartford and Wethersfield Street Railroad, Hartford, Conn., 3 miles, 3 cars; Marlborough Street Railway, Marlborough, Mass., 3 miles, 3 cars; Naumkeag Street Railway, Willow's Branch, Salem, Mass., 2 miles, 6 cars; Nashville and Edgefield Street Railway (in part), Nashville, Tenn., 9 miles, 10 cars; North Edgefield Street Railway, Nashville, Tenn., 2½ miles, 2 cars; Quincy Horse Railway, Quincy, Ill., 11 miles, 13 cars; South Nashville Street Railway, Nashville, Tenn., 5 miles, 10 cars; Wilmington City Railroad, 8th Street Line, Wilmington, Del., 1½ miles, 3 cars; West End Railroad, Brighton Branch (in part), Boston, Mass., 10 miles, 20 cars; Troy and Lansingburg Street Railway (in part), Troy, N. Y., 6 miles, 6 cars; Amsterdam Street Railway, Amsterdam, N. Y., 4 miles, 6 cars.

THE RIES ELECTRIC TRACTION SYSTEM IN CANADA.

An interesting novelty is now on exhibition, says the *Montreal Gazette* of Oct. 2, in the office of Mr. D. H. Henderson, room 12, Temple building. It is a model locomotive fitted with an invention by Mr. Elias E. Ries, by which, it is claimed, the traction power of a locomotive is increased by from twenty to thirty per

cent. The invention, which is very simple in character, was explained to a number of railway men and others yesterday afternoon by Mr. Albert H. Henderson, general manager of the Ries Electric Traction and Brake Company of Baltimore, who made the experiments very entertaining. These went to show that the invention, which should be seen to be understood, increased the power of an engine on a heavy grade by about 20 per cent., and it is agreed by the promoters that its adoption by railway companies generally would prove an economical venture. The model will be on view at Mr. Henderson's office for several days and should be seen by all our railway engineers and others interested.

THE INTERIOR CONDUIT CO'S UNDERGROUND WORK AT MINNEAPOLIS.

The Interior Conduit & Insulation Co., of New York, who have some 150 miles of their underground conduits in successful operation in Minneapolis, carrying the feeders of the overhead trolley system of the Minneapolis Street Railway, will have an excellent exhibit of their admirable system at the Convention of the American Street Railway Association, at Buffalo. The exhibit will consist of the one-half size model of their new man-hole, and will show their improved methods of entering the conduits into the same and other interesting details of the system.

MR. C. C. WARREN.

Mr. C. C. Warren, heretofore connected with the railway department of the Westinghouse Electric and Manufacturing Co., has resigned his position. In accepting the resignation the company have acknowledged the valuable services rendered by Mr. Warren, and have expressed their regrets at the severance of their connections. Mr. Warren proposes to return to Chicago.

GROWTH AND ACTIVITY OF THE CENTRAL ELECTRIC CO.

When the Central Electric Company moved into its present quarters, 116 and 118 Franklin street, Chicago, last January, it was thought that the immense floor space would be sufficient for a healthy increase of the business for five years at least, but in less than six months they have been crowded for storage room and have had to go outside to obtain relief. This is evidence of the immense growth in the electrical business generally, but is particularly expressive of the success of the Central Electric Company. It is not hard to account for this success, as a glance through the establishment will show any one at all familiar with the technique of the business that the Central have gathered to themselves a list of high class specialties that are in constant demand, and could not help making any concern of healthy business methods grow. The personnel are men of tried merit and experience in the business, and attend closely to the needs of their patrons and deserve success.

The orders received for Okonite wire by the Central Electric Company within the past week have been greater than ever before in the history of the business, and this speaks volumes for this excellent and unsurpassed wire, as there have sprung up many competitors that have attempted to challenge Okonite, but Okonite still maintains its lead and high prestige.

The Central Electric Company have made advantageous arrangements to furnish telegraph, telephone and electric light poles at the lowest market rates, having established a yard in Chicago, where they will keep on hand a full stock at all times.

The Central Electric Company are decorating their handsome store with a fine line of high glass electroliers and single brackets. This department of their immense business is becoming a very important one, and the most fastidious taste in this line can be satisfied by examining their stock of these goods.

CHARLES L. EIDLITZ.

No name is better known in architectural and building circles in New York city than that of Eidlitz, and it is now the intention of Mr. Charles L. Eidlitz to extend that reputation in the field of electrical work. He has purchased from Mr. Augustus Noll his interest in the firm of Augustus Noll & Co., in which he was formerly a partner, and is now running the business under the firm name of Charles L. Eidlitz, at 10 West 23rd street, this city. He has also closed out his interests in the New York Electrical M'f'g. Co., of which he was formerly treasurer. Mr. Eidlitz, although operating under the new arrangement but three weeks to date, has already secured contracts for electric lighting work amounting to $30,000, and he has several other orders maturing. He does not limit himself to electric light wiring, but prepares specifications and plans, and undertakes large bell and burglar alarm installations.

AN ELECTRIC ROAD FOR SAN FRANCISCO.

The new stockyards company that is to establish meat-packing works at Baden in San Mateo county will run an electric railroad from that place to San Francisco. Passengers will be carried during the day, and all night light freight trains carrying meats and vegetables will be run. This road will serve to develop the southern suburb of the city, which has long needed rapid transit.

NEW ENGLAND TRADE NOTES.

T. M. Foote Regulator Company is the name of a company organized some time ago for the purpose of manufacturing and introducing the T. M. Foote intermediate speed regulator, a machine specially designed for application to water wheels, steam engines, electric motors, or any source of power which is apt to have a variable speed, so that a perfectly regular speed may be transmitted to the work to be done. The application to dynamos, which of necessity require a perfectly constant speed is peculiarly serviceable, when they are driven by variable power, and especially when water power is used. The regulator resembles in some degree a friction clutch, and is absolutely positive in its action, and is little liable to get out of order. The company have already a large number of these regulators in service, and they are at present engaged in putting in a 40 inch regulator, of 130 h. p., in the plant of the Consolidated Electric Light and Power Company, in Dover, N. H. The headquarters of the company are at 271 Franklin Street, Boston.

Drake, Paysan & Whittier is the name of a new partnership formed in Providence, R. I., for the purpose of doing a general electric light and power construction business. They will pay special attention to the installation of insolated plants, and will also handle a complete line of electric light and railway supplies. Mr. J. I. Drake is well known, having been for years connected with the Russell Electric Manufacturing Company, of Providence, the well known manufacturers of the Russell mast arm. Mr. S. R. Paysan has been in the general electrical business in Providence for 14 years, and Mr. R. H. Whittier was for some years connected with the Rhode Island Telephone and Electric Company, of Providence. The company is already in receipt of large orders, and its prospects are very bright.

WESTERN TRADE NOTES.

Mr. G. A. Edward Kohler, Western representative of the Eddy Motor Co., has sold a one-horse power Eddy motor to the United States Dental College, of Chicago, for use in their laboratory. Also a 20 h. p. machine to Mr. Andrew Cummings, proprietor of Thomson's Restaurant, where it will be employed for driving an Excelsior arc dynamo. This is somewhat of a novel but highly useful and effective arrangement.

The Illinois Electric Material Company are enjoying rapidly increasing patronage and the orders for their specialties are large and numerous. They are making large sales of their now famous "Canvas Jacket" wire. Their latest departure is the presentation of a handsome silver plated pencil, designed in the form of a spike, to all purchasers, would-be purchasers of "Canvas Jacket," or anyone desiring one, and it may be advantageously employed to note the good qualities of their goods and send in orders. All should drop them a line and receive one of these elegant and tasteful mementoes by return mail.

The Western Power Construction Co. report the demand for McIntosh-Seymour engines ever on the increase and they have on hand quite a number of important deals about to be consummated, so satisfactory have the engines already installed been. They have just sold the Chicago Edison Company another high pressure automatic engine, 18½ x 18, of 200 h. p. capacity.

Chas. A. Schieren & Company, through their Chicago office, recently received an order from the Louisiana Electric Light Company, of New Orleans, La., for 160 feet of 72 inch double leather belt and 550 feet of 48 inch double leather belt, the former being one of the largest and heaviest belts ever manufactured. This remarkable order has just been followed up by a second one for 150 feet of 72 inch double leather belt from the same company, which speaks well for the satisfaction the first one is giving.

The Electric Merchandise Co., of Chicago, have issued to their many patrons and friends a very beautiful and neat little invitation card for the Street Railway Convention, Oct. 15th, 1890, at the Iroquois Hotel, Buffalo, inviting all to call and examine the devices of their manufacture as shown in parlor F. Mr. W. R. Mason, who requires no introduction, so well known is he amongst the fraternity, will be in attendance and explain his numerous new and useful appliances and specialties for street railway work.

THE

Electrical Engineer.

VOL. X. OCTOBER 22, 1890. No. 129.

ELECTRIC RAILROADING IN TEXAS.

ONE of the interesting features of electric railway work is that it operates as a direct encouragement to the extension of long suburban lines, which could not possibly be equipped or made to pay except by resort to electricity as a motive power. Already a large number of electric roads have been built or are under construction in small towns and outlying districts, where it had before been utterly impossible to interest capital. Many horse roads constructed under similar conditions have lingered along or even been abandoned, but at the present time, the purchase of their stock or franchises has become quite a prominent industry, the intention in every case being to adopt electric motors. Wherever the plan has been resorted to and carried out, the effect has been instantaneously beneficial.

We present on this page an interesting picture of suburban electric railway extension. The photograph was taken at Fort Worth, Texas, and shows the end of one of the roads there of the Rae system, put in by the Detroit Electrical Works. Not a house is in sight. The illimitable prairie stretches out and around, and the only objects to catch the eye are the road, the cars and the cattle grazing peacefully. It will be noted that the cattle are utterly indifferent to their novel electrical surroundings. Their immediate banishment will, however, be the result of this invasion of their pastures, for the population of the city flows that way, and thanks to electricity is provided with pleasant and inexpensive new homes, of which every man can be his own landlord.

ELECTRIC RAILROADING IN TEXAS.—SCENE NEAR FORT WORTH.

A NEW STREET CAR MOTOR.

BY E. S. PILLSBURY.

IN connection with a discussion which has been recently carried on mostly by our English cousins, in regard to a new type of alternating generator brought out a short time ago by Prof. Elihu Thomson, the writer wishes to call attention to a motor recently designed by himself for street car traction, but which might by slight alteration be adapted to the generation of either continuous or alternating currents.

The machine, which is illustrated in the accompanying engravings, would appear at first sight to be quite similar to the Thomson alternator, but on close examination, it will be seen to be quite different. Like the machine referred to, it possesses a stationary armature and excites a multiple number of poles by a single pair of field coils; but while in the Thomson dynamo both fields act together to excite a revolving inductor, all of whose poles are of like polarity, in the machine here shown, coil F excites N poles Nos. 1, 3 and 5; while the core of coil F′ is

in magnetic circuit with s poles, Nos. 2, 4 and 6. Thus we are enabled, without sacrificing the advantages of this especial type of machine, to obtain a reversal of the lines of force through the armature coils instead of simply magnetizing them and allowing their cores to demagnetize themselves, and in consequence obtaining double the in-

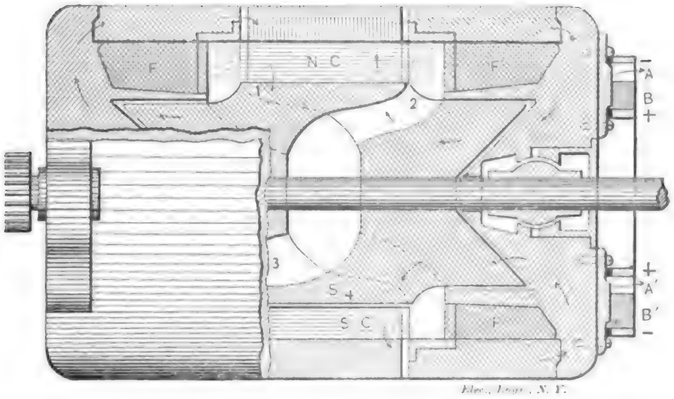


Fig. 1.—The Pillsbury Street Car Motor.

duction per turn. So much for the machine as an alternator.

But it is as a continuous current motor to which the machine shown is especially adapted. F and F′ are the field coils, and C is the armature. The magnetic circuits are completed as indicated by the arrow heads. The armature winding is that of a regular multipolar drum, each coil covering, in the six-pole machine shown, 60 degrees of the circumference.

A and A′ represent, in Fig 2, the position occupied by one coil. The points of commutation are evidently in the centre of the field induced by each pole. A slight thickness of metal is left on the under side of the armature to protect the pole pieces from eddy currents as well as to support the armature coils which are inserted from outside. The armature is stationary, the pole pieces revolving, as do also the carbon brushes B and B′. The commutator is firmly fastened to the end of the machine, the brushes pressing against it, and at the same time against the copper rings marked + and —, which form the armature terminals.

Let us see what we have gained by the method of construction thus indicated. It has been my privilege to examine a very large number of burned out street car arma-

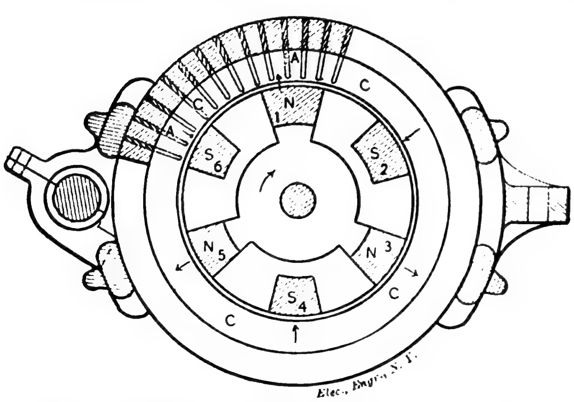


Fig. 2.—The Pillsbury Street Car Motor.

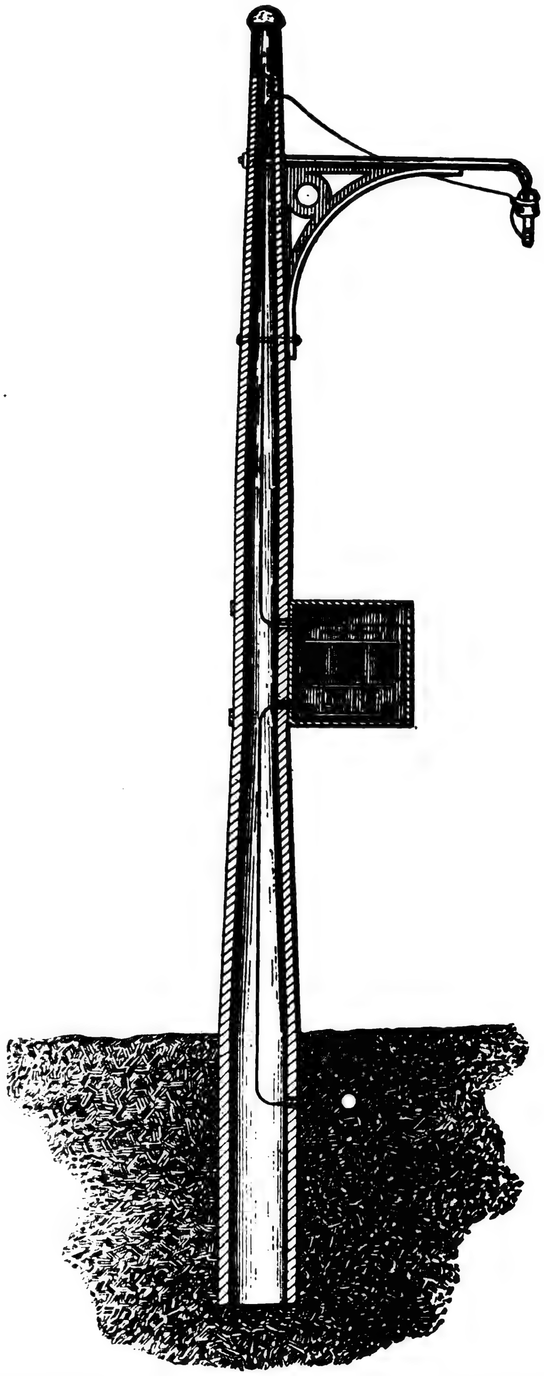
tures, and I will venture to say that 90 per cent. of these were burned out, or rather knocked out (as many were not burned out), by one of the three following causes, viz., water, vibration, and slipping of the coils on the core.

By using a stationary armature we can waterproof it much more thoroughly and avoid vibration entirely; while by using the toothed armature, we can absolutely avoid any slipping of the coils. We also have a very compact design, and can obtain at least twice the output from a motor filling the space beneath a car that can be obtained by the common designs. Again, we have our wire entirely protected by an iron sheath.

Owing to the increase in output, we propose to use single reduction in our gearing and thus obtain a noiseless set of gears. We have the solidest possible commutator, besides which it is a stationary one, and we hope thus to be able to keep it smooth enough so that it will not sing; it is also so placed as to be least likely to receive mechanical injury.

THE WHELESS OVERHEAD RAILWAY SYSTEM.

Our readers will remember that in our issue of Oct. 1 we described the ingenious electric conduit railway system



Pole of Wheless Overhead Electric Railway System.

designed by Mr. Malone Wheless and now in operation at Washington D. C. One of the principal features of the

system consisted in the arrangement by which the working conductor is divided into sections which are normally dead, but which are energized the instant a car enters upon any section; the latter again being de-energized when the car passes on to the next section. This action, it will be remembered, was performed by a switch contained in a box beside the track.

The same arrangement can evidently be applied with equal propriety to overhead systems and the accompanying engraving shows the manner in which it is carried out in practice. Here, it will be seen, the section cut-out boxes are mounted on the pole and connected to the underground feeder; the trolley line is suspended over the centre of the street. By this means each section of the working conductor, besides being controlled automatically, is under direct control for repairs and in case of accident.

MINIATURE ELECTRIC RAILROADING.

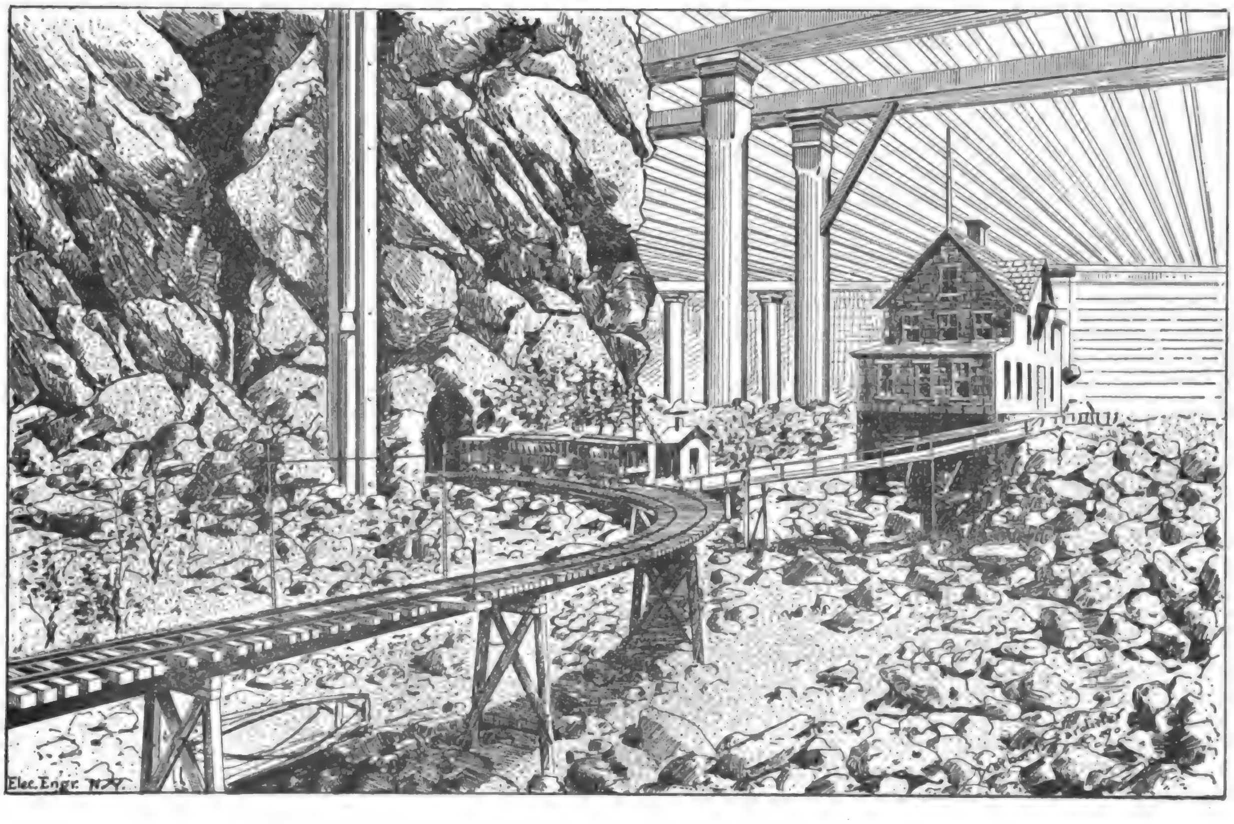
The Electrical Exhibition, just closed, at Minneapolis, was designed to demonstrate in every possible way the commercial application of electricity, and, as a consequence, many different kinds of apparatus for lighting, heating and power purposes were shown. In order to demonstrate the methods of electric railroading, and the uses to which the electric light can be put in railway working, a very ingenious miniature electric railway was operated, encircling the beautiful tower of light illustrated in our issue of Sept. 17.

This road was about 200 feet in length, supported by a trestle about three feet high above the floor, and used each rail as a conductor; that is, the two rails were used as the positive and negative conductors without any trolley system or third rail.

As shown in the engraving, the rolling stock equipment consisted of one motor car with two passenger cars. The motor was of the nominal $\frac{1}{8}$ h. p. type, 110 volts, and was fed by an Edison dynamo, which was one of those that supplied lights to the Edison Paris exhibit. The shaft of the motor was connected to the axle of the motor car by worm gearing.

The shape of the track was oblong, having four curves, a long tunnel under a large cascade, and two grades to illustrate ordinary application. The car, as it approached the tunnel, lighted miniature Edison lamps in the tunnel, for the purpose of illuminating it. It also lighted in advance each semaphore signal, and the station platforms. The road operated successfully from the start, with a single exception, when an obstruction was placed upon the track purposely, which derailed the entire train. The mill shown in the cut contained an overshot water-wheel, which was operated from the cascade above and illustrated the great milling industry of Minneapolis.

Throughout the whole exhibition this miniature railway attracted a very great deal of attention, especially from the small boys, and was very appropriately exhibited at Minneapolis, where the Edison Company are installing the largest and most comprehensive system of electric street railways in the world. The speed of this tiny train was estimated to be, in proportion to its size, equal to the speed of the Chicago limited express train on the Pennsylvania Railroad. The apparatus was built by Mr. Henry Parsell, of New York, and though small in size was accurately constructed, as its uninterrupted successful operation demonstrated.



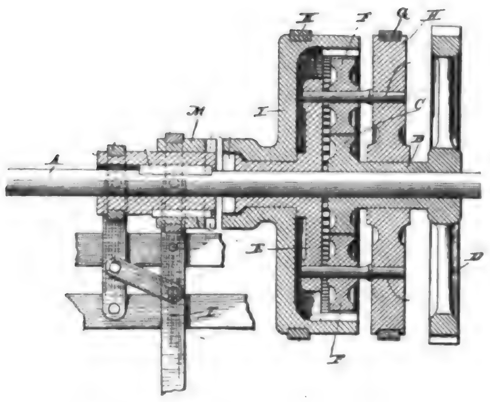
Miniature Electric Railway at The Minneapolis Exposition.

STORAGE CARS FOR DUBUQUE, IA.

The Accumulator Company, of this city, has just closed a contract with the Dubuque Street Railway Company, Dubuque, Ia., for six Edco cars, operated by "The Accumulator System." This contract was made after President Rhomberg, of the Dubuque Street Railway Company, had made an exhaustive test of the system for three months. It is the intention of Mr. Rhomberg to equip his whole road with Accumulator cars. Elsewhere in this issue will be found full details as to the system and its operation.

BALDWIN'S REVERSING GEAR FOR ELECTRIC CARS.

The most prominent direction in which inventors are at present at work in the field of electric railroading, is to relieve the motor armature of the strains which come upon it due to the frequent starting and stopping of cars. To avoid this a number of devices have been brought out, among



Baldwin's Reversing Gear for Electric Cars.

which a prominent class embraces an arrangement by which the motor armature is kept continually revolving, independent of the motion of the car.

A recent application of this nature is due to Mr. George R. Baldwin, of this city, whose gear is arranged so that the armature revolves continuously in the same direction whether the car is in motion, or not, but continues so, even when the direction of the car is reversed.

The method of construction by which this is carried out is shown in the accompanying illustration in which A represents the car axle. The armature pinion drives the spur-wheel D and its attached pinion C, which are loosely mounted by means of sleeve B on the axle A. This pinion C gears into the idler pinions F, F, revolving on pins fixed in the disc E and brake wheel H. These idler pinions also gear into the internal spur-wheel I. K and G are brake bands operated with one lever and can bring to a stop in turn either the internal spur-wheel I, or the brake wheel H, and its attached disc E. M is a double clutch to connect or disconnect from the shaft the disc or internal spur-wheel.

Taking the car at a stand-still, with the clutch and both brake bands loose and the armature revolving continuously, the different parts of the gear then revolve idly according to the laws of friction and inertia.

To start ahead, the brake G is applied and the inner clutch thrown into gear; brake K is now applied, the same movement loosening brake G; this brings the internal spur-wheel I to a stop and the idler pinions are caused to revolve around in it, carrying with them at a reduced speed the disc E whose rotation is communicated to the axle by the clutch M. To stop the car, brake band K is simply released.

To back the car, the inner clutch is withdrawn, the outer thrown in and brake band G applied; this causes the idler pinions F, F to revolve with an opposite rotation on their fixed pins and this reverse rotation is transmitted through the internal spur-wheel and clutch to the shaft.

It is thus seen that there is obtained a flexibility in the manipulation of the car independently of the motor's speed.

The constant rotation of the armature prevents the short circuits which are liable to occur from frequent reversals, and also prevents any considerable shifting of the line of commutation.

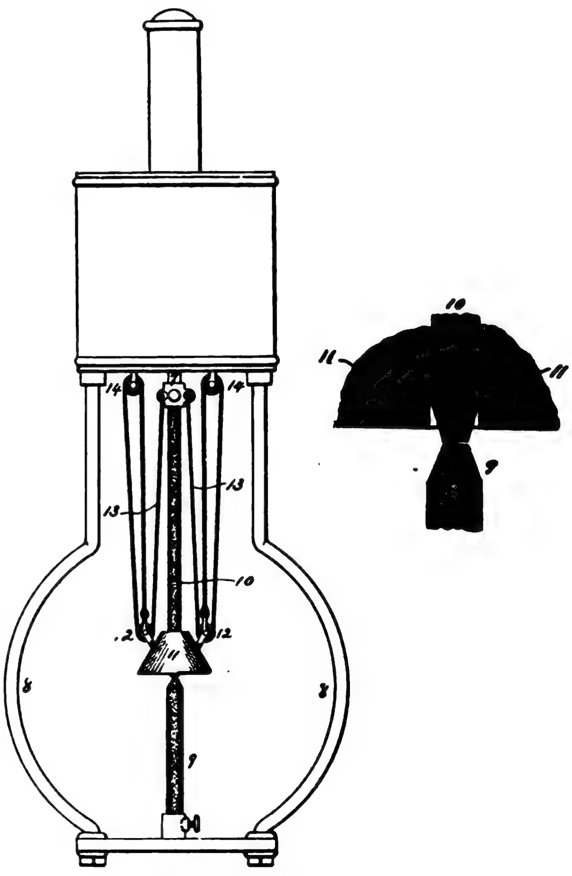
The armature is at its full speed when starting a car, thus using its own momentum to a good advantage; it is also working at its full power and greatest efficiency and is at the same time creating a counter electromotive force to prevent the excessive fluctuations of current which exert so great a strain on both the motors and generating plant.

HAZELTINE'S ARC LAMP.

An arc lamp recently patented by Mr. C. W. Hazeltine, of St. Louis, presents a distinct novelty in a peculiar method of prolonging the life of carbons. The accompanying illustration exhibits the invention clearly. Fig. 1 is an elevation of an arc lamp equipped with the invention, and Fig. 2 shows an enlarged view of the carbons near the arc, showing a part of the protective tip or shield in section.

The invention consists in the application near the arc of a protective tip or shield to prevent the rapid consumption of carbon, the tip or shield being fed as the carbon wears away.

To the upper carbon 10, a little above the arc—say one eighth or quarter of an inch—is applied a protective tip or shield 11 of refractory material, such as baked clay, porcelain or metal—having a perforation which permits the upper carbon to feed freely through it as the carbons burn away. In order to keep the protective tip or shield near the arc and receive the resulting beneficial effect, it is necessary to feed the same downward to compensate for the burning away of the lower carbon. The protective tip or shield is fed downward by the movement of the upper carbon, and to effect this a pair of pulleys are secured to the protective tip or shield, over each of which pulleys



Hazeltine's Arc Lamp.

passes a cord or chain. The ends of each of the cords are secured to the carbon-carrier, and after being carried over the pulleys 12 and 12 pass around pulleys 14 and 14, fixed to any suitable immovable part of the lamp. The other ends of the cords are secured to a bail of the movable pulleys 12. Each of the cords 13 may return upon itself three times, and will then make the feed of the pro-

tective tip or shield equal to one-third the feed of the upper carbon. In practice the lower carbon burns away about half as fast as the upper carbon when the protective tip is used. If, therefore, the upper carbon has to feed through two inches to compensate for its own consumption, it must also feed one inch additional to compensate for the consumption of the lower carbon. The feed of the upper carbon will thus be three inches in the case supposed. To maintain the protective tip or shield in the same relative position with reference to the arc at all times, it is necessary, therefore, that the shield should be fed one inch while the upper carbon is fed three inches. Care must be taken that the tip is not fed faster than the lower carbon burns away, else the tip in time will envelop the arc, and thus interfere with the proper functions of the lamp.

By applying this simple expedient to an arc lamp Mr. Hazeltine says he has found by actual practice that the consumption of carbons is decreased fully and even more than one-half, making carbons burn twice as long as they ordinarily would, without decreasing their candle-power. He is unable to account for this saving of carbon, nor does he limit the invention to any supposed theory of operation by which this result it attained. The protective shield or tip may possibly, he thinks, prevent the carrying away of any unconsumed carbon particles and their consequent dissipation and loss in the air, but may, on the other hand, operate to concentrate such carbon particles upon the arc and secure their complete combustion.

THE WENSTROM HYDRAULIC GEAR FOR ELECTRIC CARS.

It has often been pointed out that an arrangement by which the electric motor on a car could be driven continuously at a uniform speed, independent of the speed of the car is very desirable. Such a method, aside from other advantages, allows of the motor being constantly operated at its maximum efficiency, a point of great importance in the economical utilization of the current.

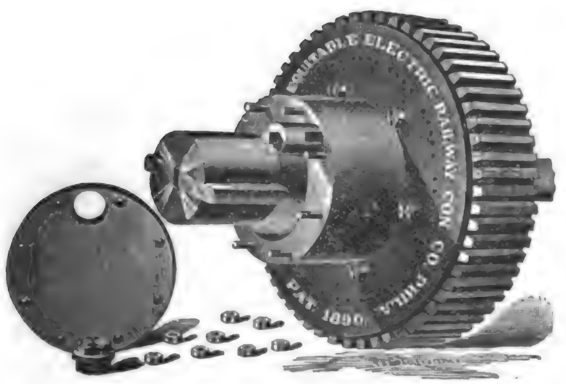


Fig. 1.—Wenstrom Hydraulic Gear, Showing Eccentric Box and Keys.

In order to accomplish this object, the Wenstrom Consolidated Dynamo and Motor Co., of Baltimore, have brought out a very simple device due to Mr. Atwood, one of their engineers, and which was shown to the delegates and visitors at the Buffalo Street Railway Convention.

The accompanying engraving, Fig. 1, shows the hydraulic gear in perspective with the end plate removed, and Figs. 2 and 3 show the same in end view and in section respectively. As will be seen, the rim which holds the wooden teeth runs loosely and free upon the axle. Within the rim, and fast to the axle is a metal disc, about three inches deep by five inches face, across which slides a brass key; the centre of the rim is hollow and is cast eccentric; in this the blank revolves, the sliding key following the interior of the eccentric box. An opening or port is cast in the rim connecting one side of the eccentric with the other through a by-pass valve. When the blank and key are in place oil is poured in, the end piece firmly screwed on and the gear is ready to operate. As the rim is revolved the oil is forced by the key, up through the opening through the open by-pass valve and into the other side of the eccentric, and, no resistance being offered, the blank and axle do not revolve.

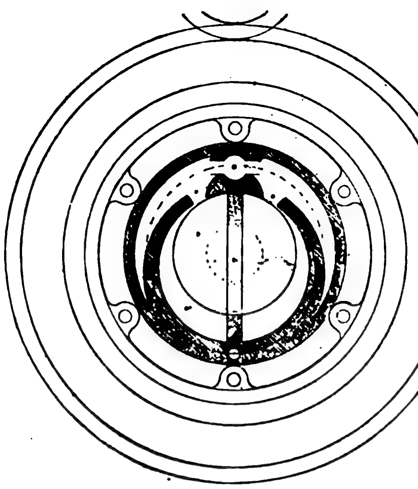


Fig. 2.—Hydraulic Car Gear—End View.

If, however, the by-pass valve be partially closed and the rim revolved the resistance of the oil is so great that the blank and axle are caused to revolve; thus by opening and closing this valve the entire speed of the car can be varied without relation to the speed of the armature, which may be kept running continuously at full speed.

It will be readily seen that with this arrangement a car may be geared to run 20 or 50 miles an hour on the level, and yet the same car may be driven up a 10 per cent. grade at only four miles an hour, with the armature running at full speed.

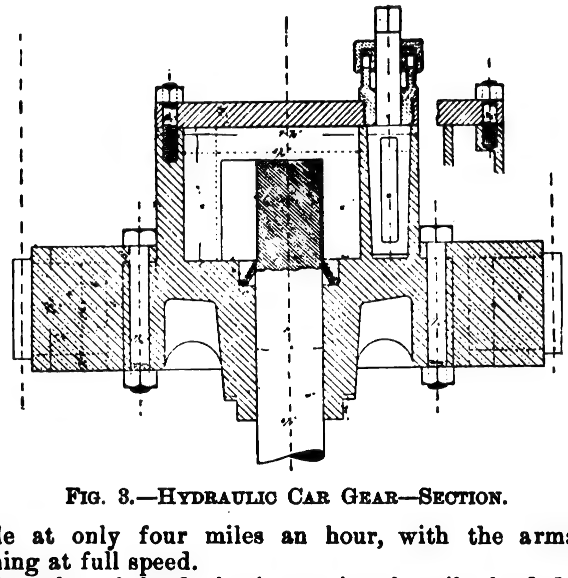


Fig. 3.—Hydraulic Car Gear—Section.

The value of the device in starting heavily loaded cars is also apparent, as any load can be started and without shock. The form of gear shown has been varied to meet different conditions but the principle remains the same in all.

The Hazeltine Electric Co. has been incorporated under the laws of the State of Missouri, with a capital stock of $650,000. The officers are: C. W. Hazeltine, president; D. R. Russell, vice-president; T. G. Portis, secretary; and W. B. Hazeltine, Jr., treasurer. The object of the company is to manufacture an attachment for arc lights which more than doubles the lifetime of the carbons. Arc lamps with the attachment are shown in operation at the Exposition, St. Louis.

NEW STEPHENSON ELECTRIC CAR TRUCK.

In applying the experience of over fifty years in the building of street railway cars, the John Stephenson Co., Ld., of this city, has designed an electric car truck in the construction of which wood material has been largely adhered to without sacrificing any of the qualities desirable in a truck of this nature.

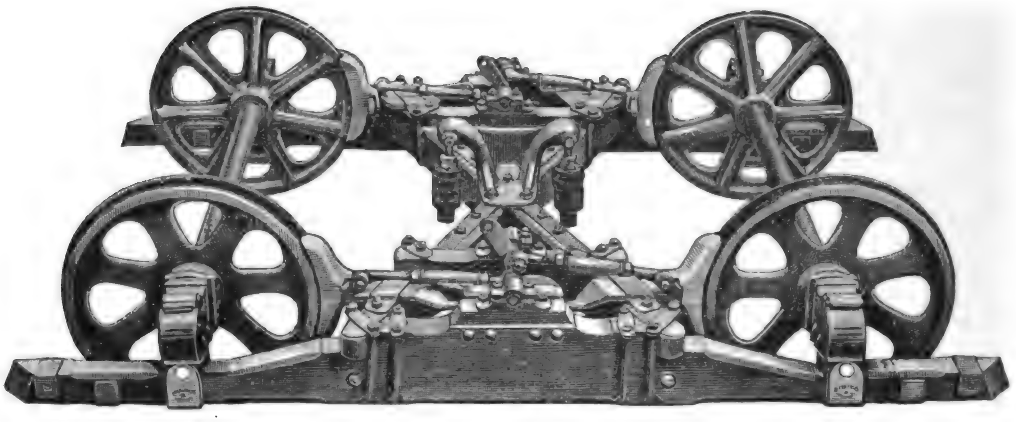


FIG. 1.—THE STEPHENSON ELECTRIC CAR TRUCK.

The accompanying engravings, Figs. 1 and 2, show the truck in perspective and in plan view, respectively, and indicate clearly the method of construction.

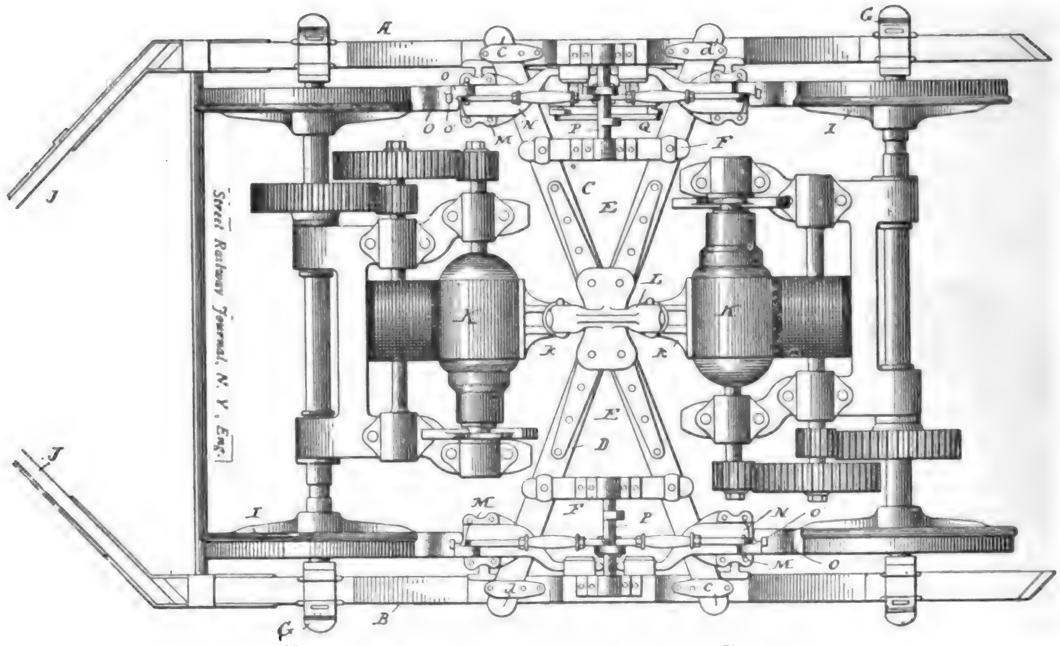


FIG. 2.—THE STEPHENSON ELECTRIC CAR TRUCK.

Among the advantages of the truck may be mentioned simplicity of construction, as but four pieces are required for the truck-frame, and the truck has within itself all needful bracing. It affords maximum room for machinery, while carrying motors and powerful brakes, free from dependence on the car body, and it is not subject to looseness of joints or change of form, and has especial facilities for repairs.

It will be seen that each motor on its axle and wheel is held to the car by three bolts, viz., a hinge joint bolted to each of the two axle-boxes and the nose bolt connecting that end of the motor with the goose-neck at the x-centre of the truck; with the three bolts named, withdrawn from their places, and the end of the car lifted, the motor with its axle and wheels may be rolled from under the car, and another motor with axle and wheels put in place in a few minutes.

It is claimed for this truck that it affords in the highest degree quiet, ease and comfort to passengers because the motor, brakes and other machinery are detached from the car body and carried by the truck with insulators intervening between the car-body and its bearings on the trucks; and for the same reason jostling and concussions are avoided. It also diminishes the wear of wheels and rails, passes curves and switches with great ease, prolongs the life service of the car and its machinery and requires less electric energy to propel the car.

A NEW ATLANTIC CABLE COMPANY.

A number of capitalists, headed by C. W. Bonynge, of San Francisco, are making arrangements for laying a new cable across the Atlantic Ocean.

The undertaking is capitalized thus: £800,000 of stock is to be taken up by eight men, at £100,000 each, to be fully paid up and no debentures issued. The cable is to be laid from Valentia Bay, on the west coast of Ireland, to a point on the American coast near New York if possible. Mr. Bonynge, now resident in London, is a San Francisco banker and broker. He says that the enterprise is already guaranteed as to its capital. It is not known whether any contract has yet been made for manufacturing the cable.

THE WINSTON-SALEM ELECTRIC PLANT.

ONLY those familiar with electrical advance know how great have been the strides made in the South. The development of the natural resources in the South has naturally brought with it enterprise in many collateral directions, and among these the electric light and power have been remarkably prominent in the last few years, hardly a day passing without the announcement of the formation of some new company for the generation and distribution of current.

A striking example of what can be done by energetic work is shown by the results obtained at Winston-Salem, N.C.

Winston and Salem are called the Twin Cities, and are practically one city, as they are directly adjoining one another, and the division line is practically in the middle of the town. The Twin City Company, which was recently organized, purchased a small local company that had been in operation at Winston for about two years, and which had an arc light plant of 50 Brush lights, and an incandescent plant of 500 Brush lights, on the two-wire system. The plant has now been converted, a new company organized, with a railway included, and a thirty-year exclusive franchise obtained. It has secured the arc light contract for both cities, comprising about 80 arc lights, and a new plant has been installed and built, everything being under one general head and management.

The accompanying engraving, Fig. 1, shows the exterior of the power building and the car house. Fig. 2 shows a perspective of the dynamo room.

The incandescent electrical plant consists of four 400 light Edison incandescent generators, with a total of 1600 lights capacity; the arc light plant consists of two 50 light Brush arc machines and the railway plant of two 50,000 watt Edison generators. The steam plant consists of two 15″ x 16″ Ball engines, one 12″ x 12″ Ball engine, three horizontal tubular boilers, heaters, pumps and general steam plant.

The plant has been built in the most substantial and thorough manner throughout; the building is entirely fire-proof, and follows the general New England "mill construction," (with one-story open roof), in floor and roofing, the rest of the building being entirely of brick. That it is fire-proof is shown by the insurance given, in a town like this, where there is practically no fire department, the insurance being at the very minimum rate. The building, the plan of which is shown in Fig. 3, comprises engine and dynamo room, 60′ x 60′; boiler room, about the same size; offices and workshop, and a car house 90′ x 60′, with a pit under the entire house.

The railway equipment consists of five miles of track, covering the general territory of the town, and reaching to all the depots and large factories. There are seven passenger cars and four freight cars running, the company intending to do a large freight business from factories and for building work.

There are 38 tobacco factories and warehouses in the town, which ship 15,000,000 pounds of tobacco every year. The roads have been very bad in this neighborhood, and the grades very steep; hence the company expects to do a profitable business in this line of freight handling.

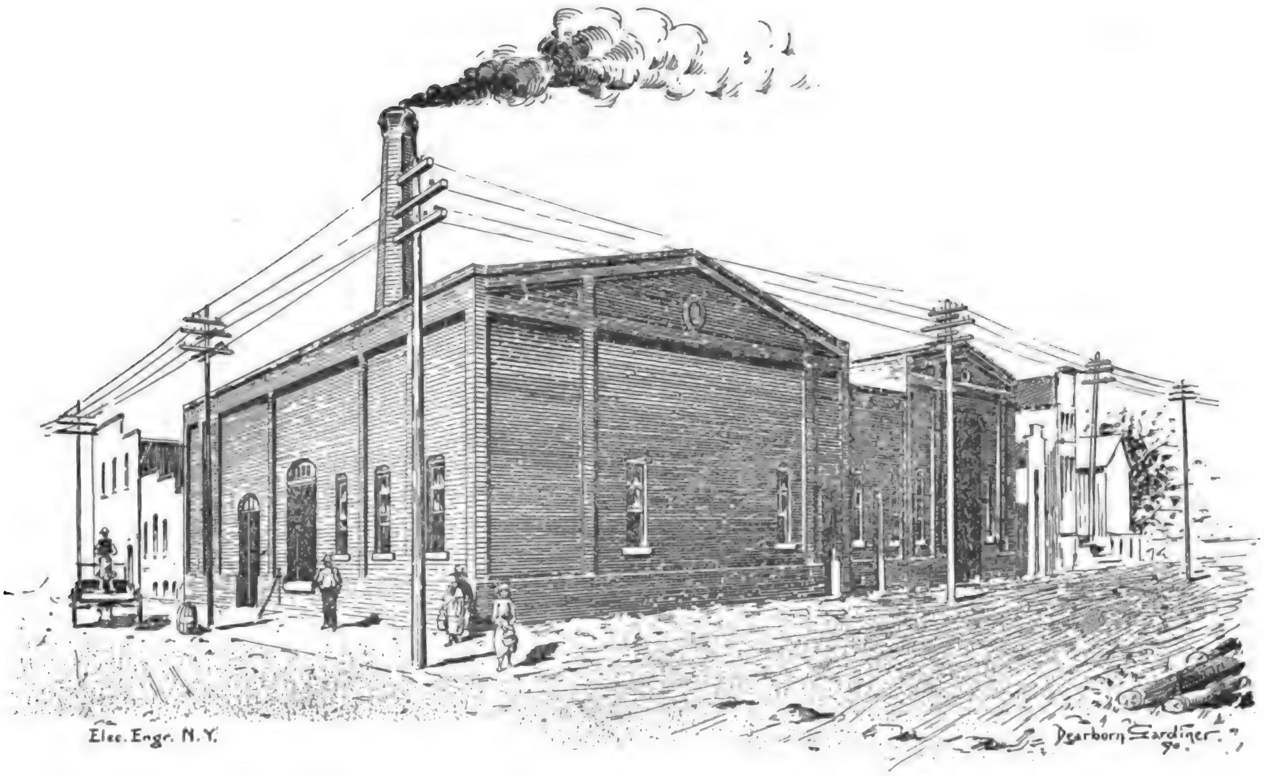


FIG. 1.—THE WINSTON-SALEM, N. C., ELECTRIC LIGHT AND POWER STATION.

The town is in one of the finest parts of North Carolina, and at present is the second city in the State. Besides the tobacco manufactories, there is a large Military Academy just being completed. Salem is the oldest Moravian town in the South, and has the oldest Young Ladies Academy and Boarding School in the Southern States, with over 500 scholars. A large winter resort hotel is also being erected there.

The plant was started up about the middle of July. The Field Engineering Company, of this city, who make a specialty of railway and central station construction, were the general contractors for building the steam plant, electrical plant and for the line construction. The track was laid by the Twin City Company, under the supervision of Mr. J. L. Ludlow, city surveyor and engineer of the company. The work was carried on under the difficulties of obtaining material so far from main sources of supply, but nevertheless accomplished in a short time.

Although the plant has been running only a few months, it has clearly demonstrated the advantages to be gained by a combination plant of this kind, which is one of the first of its class. In a small plant the labor account amounts to about 50 to 60 per cent of the operating expenses, and by combining the plants for lighting and railway purposes the labor account increases very little, thereby effecting a large saving. This is fully demonstrated by the operating accounts of the company. Mr. J. S. Badger is general manager for the Twin City Company at Winston-Salem.

The plant at Winston-Salem, is owned and operated by the Twin City Construction Company, of which Mr. J. H. McClement is president, Mr. F. A. Mason, secretary and treasurer, and the principal owners are Messrs. McClement, Johnson and Sprague. The Twin City Company is the general company, controlling the Winston-Salem Electric Railway and Lighting Company, of which Mr. F. J. Sprague is president. These are practically one and the same company, and are composed of New York parties, Messrs. McClement, Sprague and Johnson being the principal owners and controllers.

Great credit is due to Messrs. Sprague, McClement and Hawks, the principal promoters of this enterprise, for the pluck shown in attempting and successfully carrying out a piece of work, the returns from which already confirm the correctness of their judgment. The consolidated property on the basis of the first three months' operations, upon what is at best but a partially developed enterprise, is earning a dividend of about 8 per cent. over all fixed charges.

De Soto, Mo.—B. J. Arnold, St. Louis, representative of the Thomson-Houston Electric Co., has closed a contract for 1,300 incandescent lights for De Soto, Mo. Two 650 light alternators will be used.

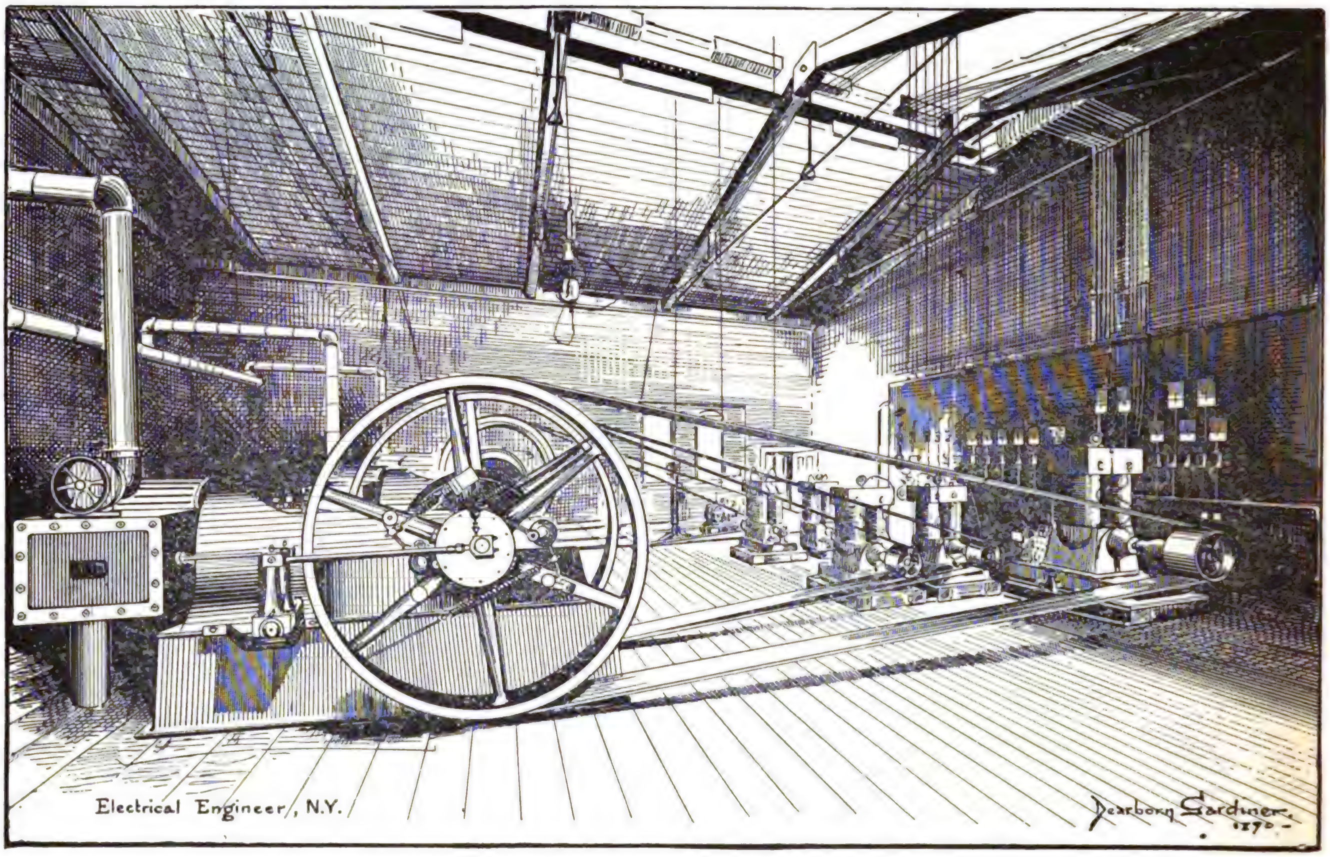


Fig. 2.—The Winston-Salem Electric Light and Power Station.

ELECTRICITY IN A SILVER MINE.

Since the operation of electric machinery of the Westinghouse manufacture has been such a wonderful success in several Pennsylvania coal mines, the demand for that company's apparatus is rapidly increasing, and its fame has even extended to the large mining districts of Colorado. The result of this has been that the Westinghouse Company is now engaged in manufacturing power apparatus for the operation of a silver mine owned by the Gold King Mining Company, of Telluride, Col., Mr. L. A. Bunn, of that city, being the president of the company. The mine in question is situated on the top of a mountain about 2,000 feet high, and as the cost of coal is a great factor in the operation of a mine under such circumstances, the advantages of electric power over steam can be easily appreciated. At the foot of this mountain is a very strong waterfall, and this power the mining company intends to utilize in conjunction with the electrical apparatus. It has been decided to place the electric plant containing apparatus to generate 100 h. p. near this waterfall, and by this means the power is to be transmitted to the motors at the summit of the mountains, where the mining operations are being conducted.

The Emerson Electric Maufacturing Co. has been incorporated under the laws of the State of Missouri; capital stock, $50,000. The company will manufacture the Emerson electric meter for alternating currents, also other electric machinery and appliances. Permanent quarters have been secured at 513 Elm street, which is being fitted up with electric power and a full line of machinery, tools and accessories for the manufacture of all kinds of electrical apparatus. The officers are J. W. Emerson, president; C. R. Meston, secretary; and A. W. Meston, lately of the Southwestern Electrical Engineering Co., consulting electrical engineer.

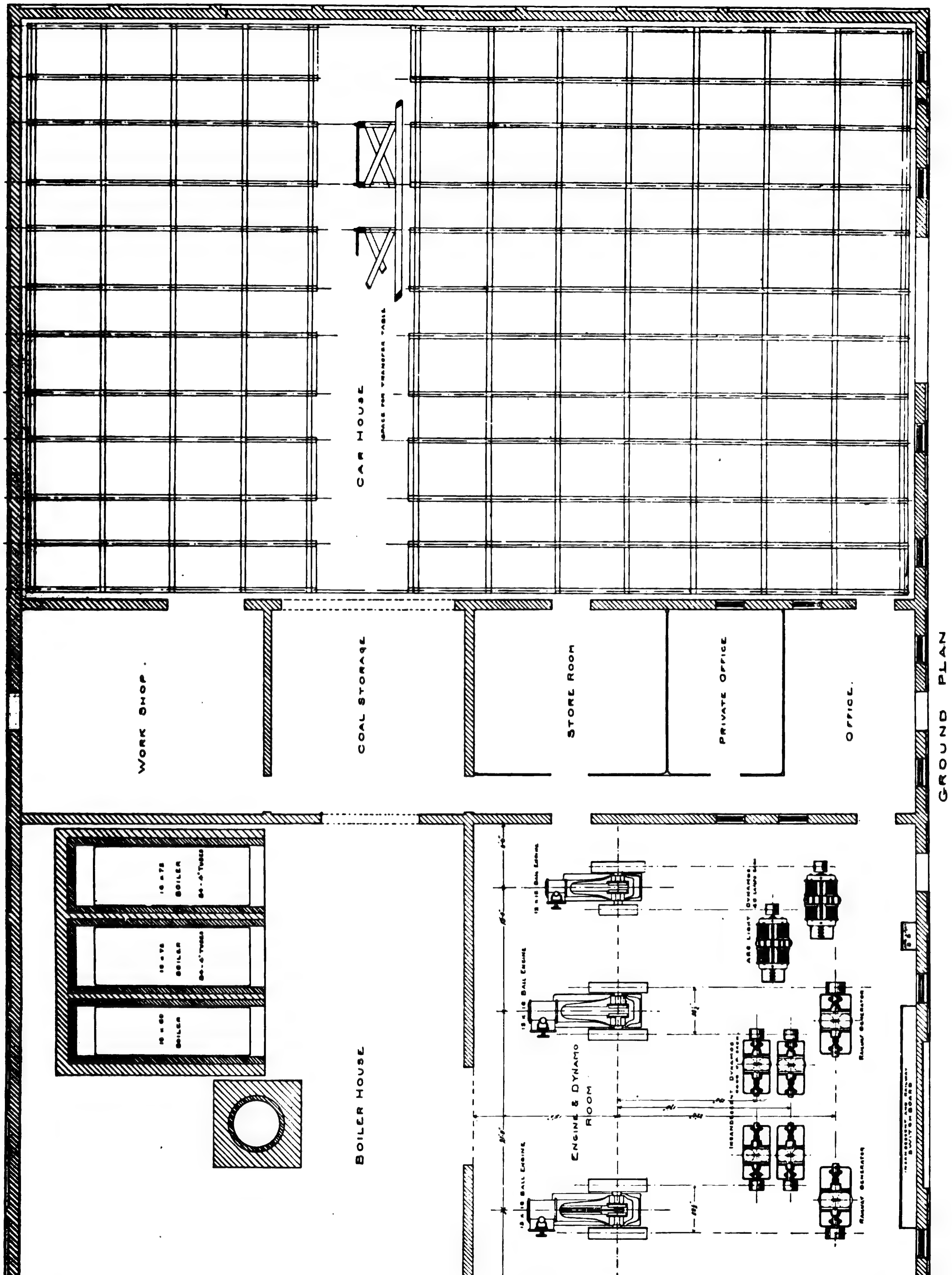


FIG. 3.—PLAN OF THE WINSTON-SALEM, N. C., COMBINATION ARC, INCANDESCENT AND ELECTRIC RAILWAY PLANT.

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GEO. M. PHELPS, President. F. R. COLVIN, Treas and Business Manager.

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.

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VOL. X. NEW YORK, OCTOBER 22, 1890. No. 129

I believe this is the last convention that will ever seriously consider horses for the operation of street railways.—President T. Lowry.

FAREWELL TO THE HORSE—AND CABLE.

IT is not a little singular, the more so because the coincidence was quite accidental, that while one of the papers read at the great Street Railway Convention in Buffalo last week was on the "Perfect Street Railway Horse," President Lowry in his opening address said: "I believe this is the last convention that will ever seriously consider horses for the operation of street railways." What a wonderful change of front this is! Only two years ago, in Washington, one of the delegates to the convention then sitting there, after listening to all the claims the electrical people were making, rose and entered his protest against all that new-fangled talk. He came there to learn something about horses. He wanted to know how to shoe them, how to feed them, how to dispose of their manure. And as he grumbled, there was evidently in more than one spot a sympathetic response and echo.

But the street railway companies of America are rapidly going out of the fertilizer business, and so far from caring whether they can get a perfect horse or not, their President says they will discuss horses no more. Another striking feature of the occasion was that the gentleman who was to report on cable systems did not do so, and asked for another year's time. The probability is that when the next convention comes around, President Lowry's successor will say: "I believe this is the last convention tat will ever seriously consider ca bles for the operation of street railways."

Nor was this all. President Lowry, whose ability and foresight no one familiar with his career can question, threw aside for electric motors, a brand new cable plant worth nearly half a million dollars. Some of his fellows thought him mad, but every new electric road brings fresh tributes of proof to his courage and enterprise. Electricity has changed the whole aspect of the industry even in the short time since he took his memorable action. "Heretofore," he said in his address, "street railway securities have not been looked upon by the financial world with favor. However, since they have been so successfully operated by electricity, the financial men of the country are looking to its development and application to street railways as an additional reliable security for the investment of savings and trust funds."

Having ourselves strenuously advocated electric roads at a time when there was not a single one in operation in the country, we may perhaps be pardoned if we thus emphasize Mr. Lowry's remarks to-day, when more than 30 per cent. of American street railways are definitely committed to electricity, and the new accessions to the electrical ranks average nearly ten a week. It is not a supersanguine electrical inventor that is uttering these things but one of the leading citizens of one of the greatest Western cities, and a man whose worth has won him the presidency of the American Street Railway Association. Moreover, what he said was but the gathering up in a few pithy sentences of the universal sentiment of all the hundreds who met in Buffalo last week.

This moment of triumph, however, has for those interested in electrical development its duties as well as its pleasures, and electrical engineers must co-operate with local companies to perfect the apparatus and to render the service the acme of safety and comfort. To quote Mr. Lowry again: "The street railway company should be required to equip its road with the finest and most modern cars, construct the best and most substantial tracks so as to inconvenience the public as little as possible in making repairs, and in short, supply the road in every department with the best and most modern appliances of all kinds."

A question naturally arises as to which field, in the near future, will see the greatest activity, that of the large cities or that of the smaller communities. The point is an interesting one, as the conditions to be met are extremely different. The fact that all the large cities are supplied with some means of rapid transit, makes the change to electricity slower, perhaps, for the reason that there is the existing investment. Still, in the matter of new lines, and especially of elevated roads, there is every ground for believing that they will all, and soon, be electrical. New York is slow in the matter, but both Boston and Chicago are getting ready for electric elevated roads. Turning, however, to the other class of towns and cities, we find that only 476 of them enjoyed rapid transit advantages at the beginning of this year, with a total of 807 roads. How inadequate this service to needs is may be inferred from the fact that even the Census of 1880 showed 494 towns and cities with a population exceeding 5,000. Taking into account the increase during the last ten years, one can realize without much effort how greatly rapid transit facilities have lagged behind. In a word, it might be conservatively estimated that at least two or three hundred communities

around or above 5,000 population are awaiting electric roads, to say nothing of the suburbs of cities of more imposing proportions. There are also straggling hamlets, contiguous to each other, whose necessities of this nature are most pronounced, and where the advantages of electricity with its capacity for extended distribution will be most strikingly exemplified.

RAILWAY MOTOR PROBLEMS.

WHILE the majority of electric cars now in operation and building are equipped with motors and gearing of the type or plan developed several years ago, indications are not wanting to show that in a comparatively short time we shall see a decided change in the method, or rather in the details, of construction of the driving mechanism in electric cars. The main objective point towards which constructors are drifting is, naturally, the avoidance, as much as possible, of all gearing, and the elimination, anyhow, of one of the two pairs of reducing gears from motor to car axle. The means by which this can be effected are various. The most obvious, is evidently that of reducing the initial maximum speed of the motor sufficiently to allow of the discarding of at least one of the intermediate gears, and one of the methods ready at hand is now being taken up and consists in the employment of multipolar motors. By increasing the number of poles acting upon the armature the torque or turning moment can be increased almost in direct proportion to the number of such poles; and since the work of a motor is equal to the speed multiplied by the torque, an increase in the latter necessarily allows of a proportional diminution in speed to obtain the same power. The construction of multipolar machines for stationary purposes has already given rise to a variety of designs, which bid fair, however, to be largely increased by inventors in their endeavors to apply them to traction purposes. Our readers will therefore be interested in the railway motor proposed by Mr. E. S. Pillsbury, which is described elsewhere in this issue, and in which the designer has sought to meet some of the prime conditions of successful operation.

But while some are rightly bending their energies in the direction just indicated, others are seeking an additional solution of the problem in a gear, which, while permitting the motor to revolve constantly at its most economical speed, will allow the car itself, at the same time, to be driven at any desired speed. We have already described a number of such arrangements, mostly of a mechanical nature, and in this issue another such is to be found. The search after a method which shall permit of such a regulation without shock, and hence involving no rigid parts, has led to the serious consideration, in more than one quarter, of an hydraulic method of transmission, in which the power is transferred through the medium of a liquid. Our readers will remember such a device, consisting of a turbine-like arrangement which was recently described in our columns and was also due to Mr. Pillsbury. In this issue we draw attention to another ingenious application of the hydraulic method,—namely, that just brought out by the Wenstrom Company, in which a very simple device permits of a ready variation of car speed independent of the motor. While undoubtedly obviating the strains which would otherwise be brought upon a motor run at greatly varying speeds, the question naturally arises as to the efficiency of such variable transmitting gear. Its use must, of course, involve some loss, but it is argued, and with good reason, we think, that such loss is considerably more than compensated for by the higher average efficiency obtainable in a motor running at its most economical speed, while it affords in addition all the other advantages above pointed out.

We must, however, not lose sight of the fact that the advocates of direct gear from motor shaft to car axle have claims upon our attention which it would be folly to ignore. Indeed, recent progress in this direction has been so marked that we are certain to see a more extended application of direct gear in the near future.

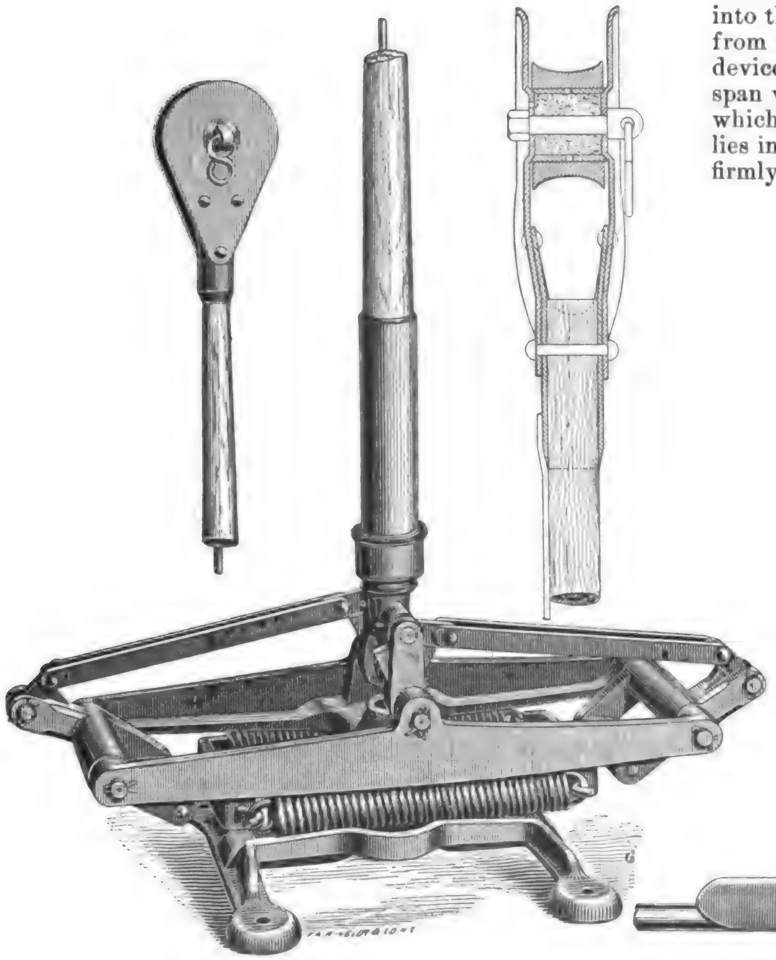
These, in brief, are the conditions which confront the electric railway engineer. Each method has its own particular advantages and local conditions as well as other considerations must dictate the one to be employed. There is certainly variety enough to meet all the conditions which may arise in practice.

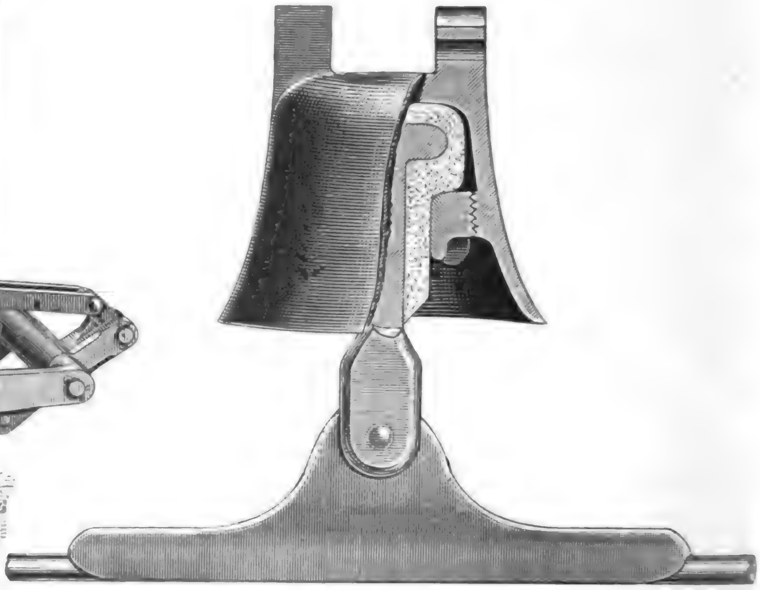
COMBINATION CENTRAL STATION PLANTS.

IN our last issue, in reviewing the history of electric lighting and power in this country, we took occasion to point out that experience afforded good grounds for the assumption that the future central electric station, in smaller towns at least, would be a plant combining within itself all the elements necessary for a general distribution of current-power for any and all purposes to which heavy currents are applied. That we are nearer to the realization of such a development than might perhaps have been imagined will be realized upon the perusal of the description given on another page, of the Salem-Winston combined arc light, incandescent light and railway power plant. Recognizing the economy of operating the various branches of work under one head, the promoters of the enterprise wisely acquired the rights of an existing company and with this as a nucleus have built up a business which after only a few months shows a good balance on the credit side. The course here pursued was evidently in marked contrast to a practice which has obtained in our smaller towns, of working electric light and railway plants entirely independent of each other, in the face of the fact that the cost of attendance in small plants is the largest item in maintenance, and that this item remains fixed over a considerable range of size of the plant. But without waiting for this increased economy to be realized by companies yet to be organized, it is evident that the same benefits can easily be secured by existing concerns by mutual arrangement. The Winston-Salem plant is another example of the opportunities for profitable investment to be found in the electrical field, and will, we hope, be the pioneer of many others as its promoters themselves have been pioneers in two of the most important branches of applied electricity. A feature of the Winston-Salem enterprise, which also deserves special notice is the introduction of freight traffic as a part of the railway business. This has already been attempted in one or two instances and no reason is apparent why the handling of freight should not be equally as profitable as that of passengers, especially as it could be carried on at night when the passenger traffic does not of itself pay.

THE EMMET TROLLEY AND LINE INSULATOR.

Although the trolley illustrated in the accompanying engraving may be new to many electric railway men, it has been in use for about a year on a few roads, during which time every detail has been thoroughly standardized. The general mechanism of the base can be readily understood from the engraving. There is a battery of four springs suspended between the lower extremities of a pair of rocking levers which are pivoted at opposite extremities of the main frame. The springs are attached to swivelling blocks with screw bolts so that the tension may be adjusted from both ends. The levers are fitted with lugs which control their motion so that one holds fast while the other rocks, thus admitting of the same battery of springs being used for motions of the pole in both directions.





Figs. 1 and 2.—The Emmet Trolley Arm and Trolley Wire Insulator.

This obviates the necessity of always bending the pole one way and makes it possible to keep a light wooden pole quite straight.

The rocking levers are connected to the pole base by links. The positions of the various centres, and the lengths of these links, etc., are so arranged that the upward pressure of the pole is accurately graded to the conditions of service, and the springs are never subjected to excessive strains. The pole may be tied down flat to the car roof for an indefinite period. The highest point of the apparatus when the pole is down is nine inches above the car roof.

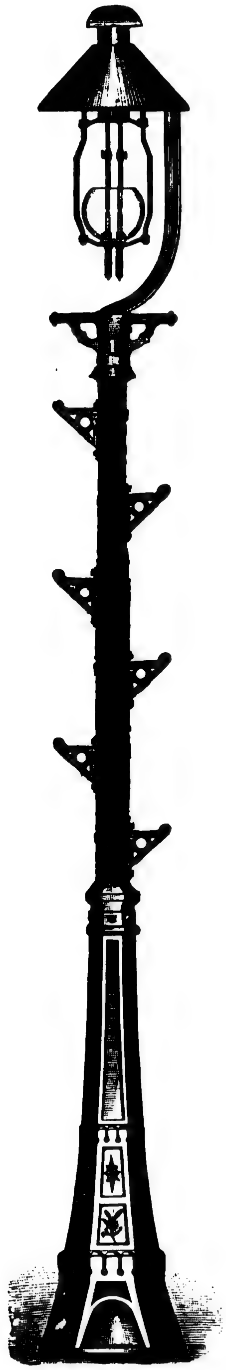
The contact roller and head illustrated in the same engraving have some novel and very convenient features. The guiding flanges, it will be noticed, are stationary, and the sheave runs between them. The shaft or spindle is a 1¼ inch brass tube, which acts at the same time as an oil reservoir, being packed with felt and oiled through a hole in one flange. The advantages of this head are its extreme lightness, sure lubrication, minimum injury to wires, and minimum cost of maintenance in repair. The sheave contains about a half pound of brass. It can be changed from the rear platform of a car in one minute and its life has been in some cases over three months, one having actually made 10,000 miles. The same firm also manufacture a wheel trolley, which weighs only a trifle more than the one illustrated; it has the same method of lubrication. These wheel heads are furnished in aluminum if desired, at a slight additional cost. The wheel head is used with the same pole and spring device. The bell trolley line insulator, illustrated in Fig. 2, is an economical and thoroughly serviceable device. It is made of iron and has a malleable iron stem with a button; this is encased in semi-vulcanized rubber, and is held firmly in place by a ring which screws into the interior of the bell. The insulation is protected from the weather; it is tough and elastic, and the whole device is practicably indestructible. It attaches to the span wire in a particularly convenient and secure manner, which, however, is not shown in the cut. The span wire lies in grooves in the lugs on top of the insulator, and is firmly held there by a piece of wire, which passes through holes in the same lugs and is attached to the span wire on each side by a half connection. These devices and many others covering the whole field of overhead railway work are manufactured by Messrs. Emmet Bros., of this city.

The Walworth Light and Power Company, whose central station is at 33 Hawley street, Boston, have installed a 150-horse-power nominal Lane & Bodley Corliss engine. The engine has one cylinder 18″x42″ and makes about 75 revolutions per minute with about 75 pounds of steam. The high speed engines have all been taken out and the dynamos are run from a countershaft by means of the Evans friction system, two dynamos being driven from each pulley. The Walworth Company by this means have reduced considerably their running expenses, and when it is taken into consideration that they supply about $7,000 worth of steam heating for offices in the vicinity, with their exhaust steam, it will be seen that the station can be operated very economically. They are at present running about 1,000 incandescent lights and 50 arc lights, and are increasing continually.

THE COLUMBIAN STREET LAMP POST.

In electric lighting systems for street illumination a demand has arisen for posts that, in addition to filling the well known electrical and mechanical requirements, shall present a symmetrical and pleasing appearance, and a glance at the accompanying illustration will show the success in that direction, which has been obtained by the Western Electric Co., in their new "Columbian" street lamp post.

The lower part or base of the new post, which is of cast



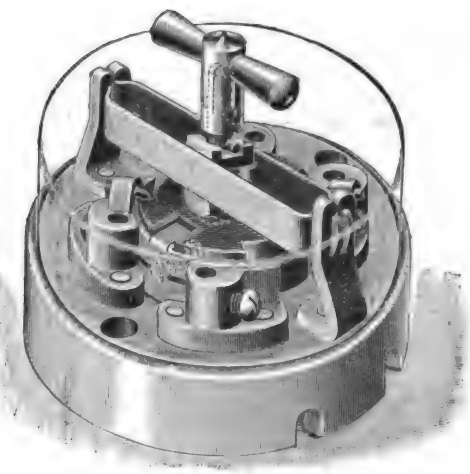
The Columbian Arc Lamp Post.

iron, has a broad circular footing, which, when bolted to the walk, gives the post great stability. Above the footing the base assumes a hexagonal section, and rises in graceful curved faces, paneled and ornamented in a tasteful manner. One of the panels is hinged so that it may be opened to give access to the switch. The wooden portion of the post extends downward through the cast iron base to the sidewalk, and above the base is provided with neat malleable iron steps, while at its upper extremity is carried a single side arm lamp support with switch-board and hood of the well known pattern adopted by the Western Electric Company. The height over all is 21 feet 2 inches.

THE PERKINS SNAP SWITCH.

The necessity of a quick make and break in an electric light and power switch is now well recognized, and to meet this requirement Mr. C. G. Perkins has recently designed the snap switch, shown in the accompanying engraving, the manufacture of which is now being carried on by the Perkins Electric Switch Co., of Hartford, Conn.

As will be seen in the accompanying engraving the moving contacts carry at their centre a lozenge-shaped piece which moves between two springs, so spaced as just to span the narrow side of the lozenge. When the handle is turned, the longer ends of the lozenge press against the springs, distending them until the long



The Perkins Snap Switch.

ends bear full against the springs. The slightest movement beyond that point, however, at once causes the springs to complete the throw of the switch by a snap movement, and to open or close the contacts independent of the movement of the handle. It will also be noticed that in order to facilitate the quick snap the lozenge is provided with roller bearings so as to reduce the friction to a minimum.

The parts are mounted on a porcelain base and are all made interchangeable. The construction is such that a good rubbing contact is obtained.

These switches are made so as to be used in connection with both concealed and cleat work, and both in single or double pole types. They range in capacity from 10 to 100 amperes.

ELECTRIC RAILWAY WORK OF THE THOMSON-HOUSTON ELECTRIC COMPANY.

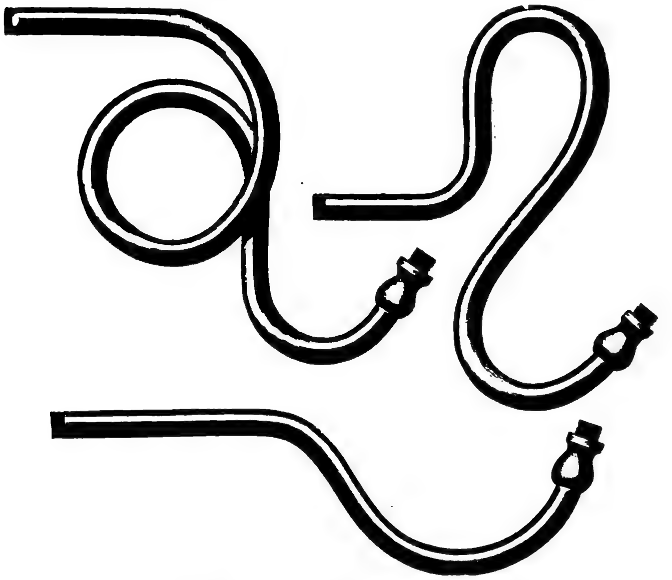
During the past two months the Thomson-Houston Electric Company has been actively engaged in completing the construction of, and has put in operation, electric railways at Concord, N. H., Shreveport, La., Newark, N. J., St. Paul, Minn., Memphis, Tenn., Anaconda, Ont., Helena, Mont. These roads comprise 50 motor cars, and 33.54 miles of track. The St. Paul road was put in operation on Oct. 6th, 1890, and has been running satisfactorily ever since. The Concord Horse Railroad, Concord, N. H., 8 cars and 7 miles of track, was started Oct. 8th, the trial car having on board the officials of the road, and invited guests. Everything in the working of the system was excellent, and the best of results are anticipated by the officials of the road. The road of the Shreveport Land and Improvement Company, Shreveport, La., 4 cars and 5.25 miles of track, was put in operation Oct. 4th, and opens up for residence a large territory owned by the Shreveport Land Company. The initial run was made without an accident of any kind, every car being utilized, and working to the entire satisfaction of all present. The City and Suburban Railway, Memphis, Tenn., 5 cars and 5 miles of track, was formally opened at 5 A. M., on Oct. 6th, 1890. The cars all worked well and their operation on daily schedule time since the time of starting, has convinced the residents of Memphis that the benefits of rapid transit have in no sense been exaggerated. On Oct. 4th, the city of Newark turned its back on horse car traction and inaugurated

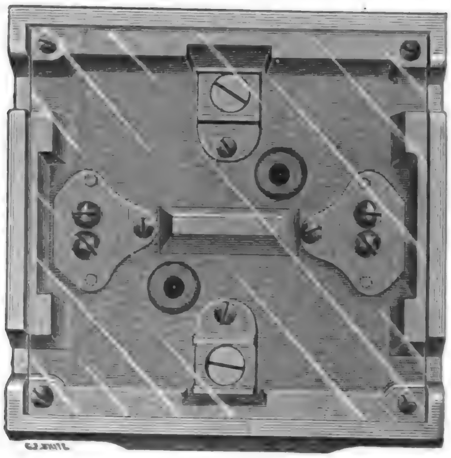
a new system which is working to the entire satisfaction of those interested in the road, and the public as well. The trial trip was a complete success. The local company have equipped 5.75 miles of track, and have 20 cars in operation. The people are very enthusiastic over the new method of transit, and predict a grand success for the electric cars in the future.

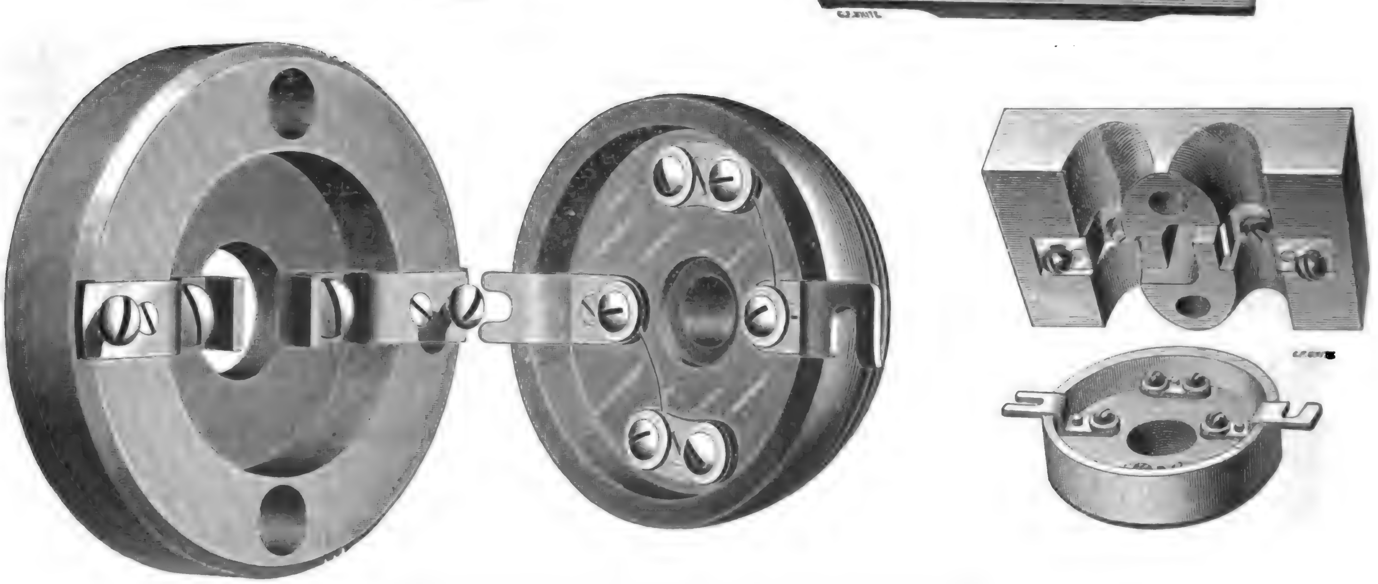
On Aug. 2d, 1890, the Thomson-Houston Electric Company commenced the equipment of the Alamo Street Railway, San Antonio, Texas, and on Sept. 25th, 1890, in less than two months, had laid 10 miles of track, put up the overhead construction, and had 10 cars in operation to the entire satisfaction of all concerned. It will be seen that this was remarkably quick time, and only goes to show that the Thomson-Houston Company employ only thoroughly competent men in their railway department.

NEW K. W. CUT-OUT SPECIALTIES.

We illustrate in the accompanying engravings two new K. W. cut-outs, which are being actively pushed by the Pettingell-Andrews Co., of Boston. The engraving Fig. 1 shows the K. W. bracket cut-out, showing the base for screwing on to a wall, pillar or other convenient place and the cut-out cover into which it is fastened; and any desired shape of bracket, three of which are shown in the engraving, Fig. 2. When the bracket is fixed in its place, in order to insert a new fuse, all that is necessary is to detach the cover carrying with it the bracket, in the simple manner well known to all users of K. W. cut-outs. Fig. 3 represents their most recent form of K. W. cut-out for moulded work, and is made in porcelain. We illustrate also the "Boston Branch cut-out," Fig. 4, which is also being introduced by the Pettingell-Andrews Co. This cut-out is made of porcelain and can be used for from 50 to 100 ampere currents. The mains come in from behind and are in electrical contact with the two brass pieces shown with three screws, while the branches run through the upper side of the box through the slots shown, and connected to the mains by fuse wire. The top of the cut-out is covered by a sheet of mica.







FIGS. 1, 2, 3 AND 4.—NEW "K. W." CUT-OUT DEVICES.

SOME RECENT WESTINGHOUSE WORK.

Among the contracts for alternate current electric lighting apparatus which the Westinghouse Electric and Manufacturing Company obtained during the last week is one from the Elmira Illuminating Company, of Elmira, N. Y. This company was organized only a little over a year ago with a view of supplying the citizens of Elmira with light. The plant erected was furnished with an apparatus of 750 lights capacity. The demand for the modern system of illumination, however, increased to such an extent that the Elmira Company was obliged to arrange for several additional alternating current machines. Three times an increase had to be made to the capacity, until to-day the central station has generating machinery for a capacity of 3,750 alternating current incandescent lamps, the last contract being for 1,500 lights.

The Westinghouse Company is also manufacturing apparatus for several other alternating current central station plants, which are already operating the Westinghouse system. There is the Oswego Electric Light Company, of Oswego, N. Y., where the capacity is not sufficient to meet the demand and a 750 light machine is being added to the plant. Lincoln, Neb., where the Lincoln Electric Light and Power Co. has been operating the Westinghouse alternating current system in a central station plant of 1,950 lights capacity, will also have more light shortly, the company having just concluded a contract with the Westinghouse Company for apparatus to generate 1,600 16 c. p. incandescent lamps.

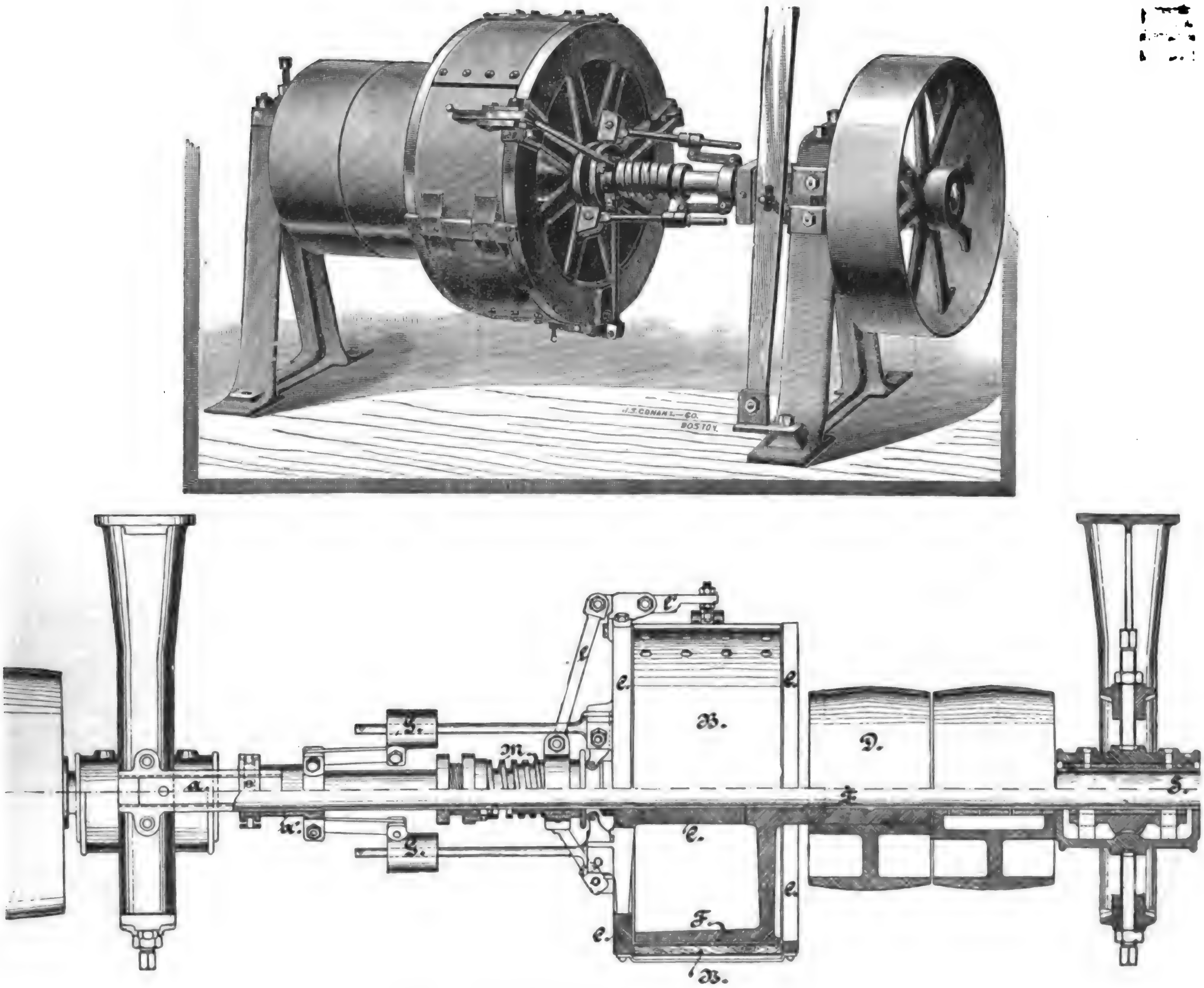
Electric lights were introduced in Tampa, Fla., in 1887, and since then the Florida Electric Company, of that city, has energetically gone to work to prove to its patrons the many advantages accruing from the use of electric illumination. Operat-

ing the Westinghouse alternate current system of incandescent lighting, their task was, of course, an easy one, and it is gratifying to know that a few days ago the company contracted for additional apparatus which will enable the Tampa central station plant to generate sufficient electricity for furnishing the city with 1,900 16 c. p. incandescent lamps.

Apart from these increases in the generating capacity which the Westinghouse Electric and Manufacturing Company has contracted to furnish, the alternate current system is also being introduced in new central stations at Durango, Cal., a plant with 750 lights capacity, and at Orange, N. J., the Westinghouse Company is also going to install a plant with its apparatus for 750 lights.

THE FOOTE SPEED REGULATOR.

While perfection in the construction of governors for steam engines and turbines has brought the regulation of such prime movers to very great perfection, there is still room for improvement in this direction and the importance of uniform speed, especially in the driving of dynamos, is too well known to need further pointing out. Again, while under small changes of load the ordinary governor may maintain the speed satisfactorily, there are numerous cases in electric work where violent fluctuations in load take place, for instance, in electric railway work.



FIGS. 1 AND 2.—THE FOOTE SPEED REGULATOR.

In order to obtain uniform speed, therefore, under all conditions, and especially in such cases where the source of power is irregular in its action, Mr. T. M. Foote has recently designed an intermediate speed regulator, Fig. 1, which automatically compensates for all changes in load and delivers power at a uniform speed to the driving pulleys of the dynamo or other machinery driven.

The main features of the regulator are a friction-coupling between the driving-pulley and the shaft to be driven, and a governor, which controls the pressure of the friction. As will be seen in Fig. 2, the driving-pulley D is fast on the projection sleeve of the friction-wheel F, the two forming one member of the friction coupling, and rotating freely on the shaft S. The other member of the friction-coupling consists of three brake-shoes B, which cover two-thirds of the friction wheel and are made of leather, backed with wood and sheet steel, which latter projects beyond the shoe, serving to fasten the same to carrier C, and giving the necessary elasticity to the shoe.

The brake-shoes are forced against the friction wheel by the spring M, which acts through levers l and l', levers l' having their fulcrums on the carrier C, which is fast to shaft, so that they all rotate together. The arms of the governor G G at their fulcrums have each an extension at right angles, which press against the spring M, so as to diminish the pressure of the same on the combination of levers and brake-shoes. The relative tension of the spring M and the amount of the weights on the arms of the governor, are determined and adjusted according to the horse-power and the speed that are desired.

This relation being adjusted, and the speed of driver D being in excess of that required for shaft, the action of the regulator is as follows: The arms of governor G G, at the predetermined speed, assume a position forming a certain angle with the shaft, and reduce the pressure of brake-shoes B on friction-wheel F to a certain amount, and this angle cannot change, nor consequently can the pressure on F, as will be seen subsequently, so long as the speed of F remains greater than that of shaft S and for which the machine is adjusted.

As the pressure of B upon F depends upon the position of the governor G, so the position of the governor depends upon the speed of shaft S; and again this very speed of shaft S depends upon

the pressure of brake-shoes B upon the friction-wheel F; so that we have three actions, pressure, centrifugal power, and revolution, forming a cycle in which each depends directly upon its predecessor and controls the next one. These three actions are constant and therefore simultaneous, and are so linked together, that the tendency of one to vary from its predetermined condition, causes the other two to react upon itself in direct opposition to its original tendency.

Let us suppose, for example, that the pressure of the brake-shoes B on friction-wheel F were increased ten per cent., the speed of shaft S would thereby be increased in the same proportion. This increase of speed again, would increase the action of the centrifugal power and throw out the arms of the governor ten per cent. beyond their normal angle, and here the counteraction would take effect, for the arms of the governor in flying out, act directly upon the spring M and diminish the pressure of the shoes on wheel F. The weights of the governor and the tension of the spring being properly adjusted, the counteraction reducing the amount of pressure must be exactly equal to the increase of pressure that caused it, and both being simultaneous, neither can take effect, so that the result is perfectly uniform speed.

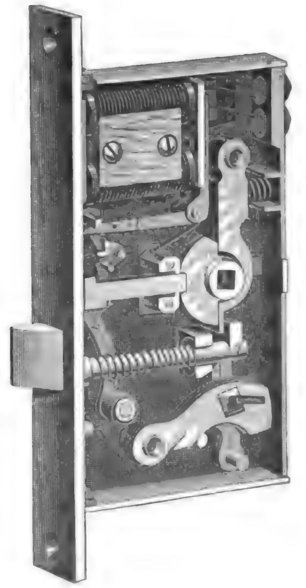
The shipper *a a'*, which changes the position of the weights on the governor, is an addition to the regulator, which increases its value in many places. By altering the distance of the weights from the fulcrum of a governor, the action of the same is greatly changed, and there is thus obtained a change of speed of over thirty per cent. while it is in motion, and still any speed it is placed at will be maintained without variation.

Besides numerous applications of the Foote regulator to the driving of dynamos for lighting and power, etc., its great sensitiveness is shown in its application to the manufacture of incandescent lamps. These having to be flashed at a predetermined voltage, it is essential that the current used for that purpose be always kept to the standard. The Foote regulator has accomplished this to perfection, thus almost doing away with the breaking of the carbon filaments, and increasing the output almost threefold.

The regulator, which is built by the T. M. Foote Regulator Co., of Boston, is especially adapted for dynamos driven by turbines and irregular acting engines.

THE THAXTER ELECTRIC LOCK.

The advantage of being able to control the opening of doors by the pressure of a push-button situated at any convenient place is now so well recognized that many private residences, apartment houses and banks are being equipped with electric door openers. In order to fulfill all the requirements of such a lock, the Electric Gas Lighting Co., of Boston, are now offering



THE THAXTER ELECTRIC LOCK.

to the trade the improved Thaxter electric lock, which possesses a number of advantages.

The lock, which is both a front door lock and an electric lock combined, is shown in the accompanying illustration.

The pressure of a button, conveniently located, closes the circuit, and the current passes through the magnet, releasing a lever; the spring then throws back the bolt from the tumbler, when the outside knob can be turned and the door opened. The door locks itself when it closes.

The catch of the lock can only be released by the push-button inside the house, or by use of the pocket key, but can not be released by thumping on or jarring the door. In fitting the Thaxter electric locks no cutting of the door jambs is necessary, which is an important advantage.

WHITE AND CARHART ELECTRIC BELL.

The accompanying engraving illustrates a new form of electric bell, the invention of Mr. J. W. White, of Providence, R. I., designed for all classes of work where electric bells are used. The

THE WHITE AND CARHART BELL.

frame is of cast iron and is shaped like a horseshoe, the magnets and hammer being similar in design to those of all other bells. The chief difference is in the bell itself, which is composed principally of a spiral steel wire, which may be either flat or round in section, free at one end and attached at the other to a metal sounding base shaped like an ordinary small bell. The sound given out by this bell is soft and much more melodious than that of other bells. The bells are neatly finished, and no cover is required, the horseshoe shape giving it quite a handsome appearance and making it an ornament to any location. The price is only a trifle higher than those of the ordinary manufacture. The bell is being put on the market by Mr. E. M. Carhart, 18 Custom House street, Providence, R. I.

NEW YORK ELECTRICAL SOCIETY.

A very interesting paper will be read before the Society on Thursday, Oct. 23, at 8 P. M., by Lieut. Bradley A. Fiske, U. S. N., on "The Modern Electrician in Time of War." The meeting will be held in Prof. Chandler's lecture room at Columbia College. All who are not members of the Society are cordially invited to attend.

BROOKLYN INSTITUTE'S ELECTRICAL EXHIBITION.

The Department of Electricity will make an exhibit of electric batteries of various forms in the large hall of the Union for Christian Work, 67 Schermerhorn street, on Friday evening, October 31, from 7:30 to 10 P. M. The exhibit will include not only batteries in working order, but the parts of batteries and appliances used in the manufacture of them.

Each member of the Department who desires to make an exhibit of apparatus of the kind described should inform the Chairman of the Committee on the Exhibit of Electric Batteries what exhibit he proposes to make, and what table space he will require, at least three days preceding the date of the exhibit. Persons not members of the Institute desiring to exhibit apparatus should make application at least four days before the day of the exhibit.

REPORT ON ELECTRIC MOTIVE POWER TECHNICALLY CONSIDERED.[1]

BY DR. W. L. ALLEN.

To go over the entire subject of electricity for street railways, and consider all the technical details, would occupy too much of your time. The subject naturally divides itself into

(I.) The Central Station.
(II.) The Transmitting Line.
(III.) The Motors.

The National Electric Light Association has so fully and exhaustively considered the matter of power or central stations that, most fortunately for street railway men, this subject is one that troubles us but little; but there are some points in which our work differs materially from that of an electric lighting station.

The engine we require must be strong in all its parts, for there is no work where the demands on it vary so suddenly and so frequently, from the entire absence of load to the extreme capacity of the engine, as in street railway work. Some roads report that the cars average but five horse-power each; supposing that such a road has eight cars in operation with one 150 h. p. engine in the station, and, as is often the case, the cars either become bunched or happen to start at the same instant; here a sudden demand is made upon the engine for 150 or 200 h. p., while a moment later the meter may register but 40 h. p. You will, of course, be provided with safety plugs and current breakers, but you cannot allow safety strips to be blown out half-a-dozen times a day, possibly just at the moment you are ascending a heavy grade.

Electric light men state that a station with a number of small high-speed engines is more economical on account of being more flexible in its operation, but in their business the loads upon the station vary gradually, while we may be called upon at any moment for our maximum capacity. To arrange our station for this varying load, and at the same time avoid operating a tremendous engine on an average light load, is a problem that experience must solve for us. We are also more greatly troubled by lightning than we should be. There should first of all be established as perfect a ground connection as possible, either by means of a well or a deep hole; it is better to have two grounds, and thereby make sure of a moist contact for galvanized ground-plates or rods; then, with proper lightning-arresters so placed that they can be conveniently examined and kept in order, we will be fairly well protected; but with our great lengths of exposed trolley wires we are very certain to have frequent calls upon our lightning arresters, and those in use at the present time are not such as to warrant perfect confidence.

Are we not all personally firm believers in the overhead system of transmission? What can there be simpler, cheaper, more durable and more convenient? We have only poles, bare copper wire, galvanized iron span wires, insulators and, where needed, additional feed-wires, of which these last can be placed under ground if desired. It is a rare thing to have a trolley-wire break except at the curves. Curves are certainly troublesome on account of the constant liability of trolleys to jump off at some sharp angle, and the trouble is more generally due to faulty trolley stands, wheels or springs than to the overhead wire. For insulators we have only those for the straight line and those for the curves; and I show you a sample of each, such as were used two and a half years ago on one of our lines. It is not to be wondered at that street-railway men at that time considered electricity, for the rough usage required by street-railway work, to be in an embryonic stage of development. There is little to be asked for in the way of improvement of what we now have for overhead material. There is practically no difference whether we use the Thomson-Houston system, Sprague-Edison, Westinghouse or what not. A single trolley wire which may be large and heavy, say, No. 00, and thus avoid feed wires where distance for transmission is not too great; or the wire may be small, say, No.4, light and easy to handle, with, in that case, the necessary feed wires. We can take our choice and find equally good results with either. It will often be convenient to utilize both plans, with the large trolley wire in the central parts of the city where feed wires might not be desirable, and with the small overhead and feed wires to reinforce the suburban parts. Undoubtedly the small wire is more easily handled and repaired in case of a break, and the feed wire prevents a dead line being the result of a break. The rail bonds may be galvanized iron, which cost but four cents, instead of tinned copper, and the supplemental ground wire can be of the same material. The supplemental wires do not give any better return except so far as to prevent a bad break in the return circuit which might occasionally be caused by the breaking of both rail bonds at neighboring joints. Rails on both sides of track should be connected with bonds.

It will not be necessary to discuss the merits of the conduit system or the storage battery. Actual experience has proven that there need be so little trouble or danger from the station and overhead line that we cannot concede the need of either conduit or storage battery, so far as *we* are concerned. It is true that the ever-restless mind of the public has been so stirred up by accounts of the numerous successful storage-battery and conduit railways that it has suddenly (and to us most unpleasantly) become aware of the fact that we are using poles, and while we are congratulating ourselves upon the beauty and symmetry of our neat line of poles, it suddenly demands that we remove what it terms our unsightly poles. Nearly everyone of the street railway men present will uphold the statement that the only problem before us, and the one about which we are always anxious, is, "What can we do to keep our motors out of the repair shop?" We don't worry about our station or our overhead wires; we scarcely have time to think of them; we are constantly at work upon and perpetually annoyed by our motors; a lame armature, a burnt field magnet, a broken gear, these are our everyday trials. A motor, such as is made by the Thomson-Houston, Sprague-Edison, or Westinghouse Companies has among its mechanical parts an axle-gear and intermediate shaft gear, shaft-pinion and armature-pinion, and the axle and intermediate shaft and armature have each their boxes or bearings. We want gear and pinions to be wide and heavy enough not to break. We don't want any more pinions like this, which was in use two years ago. We want gear of some material that will be reasonably durable, and at the same time noiseless; cast iron may do for the axle-gear, which is large and runs slower, and steel for the intermediate shaft pinion; steel, we believe, is better than bronze, as it lasts longer and is less expensive. To overcome the noise, it is necessary either to have the gear covered and running in oil, or to have the gear of wood or the pinion of raw hide. The large gear on the axle and intermediate shaft, if made with wooden teeth and used with steel pinions, certainly runs noiselessly, and it ought to make the life of the pinions much longer. Care must be taken to have the keys in all gear and pinions, tight and self-retaining. The shaft-boxes and bearings must be made of some compound metal that will not wear out too fast, for but little wear on the armature bearing will allow the armature to scrape on the pole-pieces of motor, be damaged and laid up for repairs. Aluminum bronze gives satisfaction as material for the bearings.

The electrical parts of the motor in which we are most interested are the armature, field magnets and the controlling switch or rheostat. The armature of an electric motor is its most wonderful and interesting, as well as its most expensive and troublesome part. A street car is the most overloaded vehicle known to mankind. It may run a week with a light load and then suddenly receive enough passengers to load fairly well three or four ordinary cars; the motorneer may forget to oil either the car or motor, he may reverse the motor accidentally, or purposely, to avoid an accident; these and many other causes require of an armature more work than it is capable of, hence a burn-out. On the other hand, the armature itself may be at fault; an armature such as we use to-day consists of a shaft surrounded by a metallic core. Around this core is wound the best insulated wire, each coil terminating at the same end of the armature and being attached there by means of solder or screws to the bars of the commutator. The shaft of the armature will, in a few years, become worn by its bearings, and it would be well to have bushings or sleeves placed around shaft at those points, such as the Thomson-Houston Co. use, which sleeves can be renewed. As there is no wear to the core and as the commutator can be renewed when worn down, which ought not to occur in less than two or three years, an armature should then have as long a life as one could desire were it not for the coils of wire. Where these coils cross around the head of the armature they chafe on each other and destroy their insulation. Where they end in the commutator they loosen; by an excessive load or careless driver they burn out. It may be possible to repair the armature by re-winding one coil or by re-fastening the loose ends, and even when a deep coil is burnt the total re-winding with new wire should not cost but $40 or $50. Could we but prepare for the burn-outs by having the car on some side track near the repair shop, where it would not interfere with our running time or cause a hindering of cars, we would not feel so aggravated. but it happens invariably at the time we need every car most urgently. We can watch our gear and bearings and when worn they may be replaced at our convenience or at night, but an armature gives out without warning. It is on this account that those systems advocating but one motor to a car must give us positive assurance of *no burn-outs*, for were it not for the double motor now so generally in use we would see crippled cars being *towed* into the shop greatly to our discomfiture. In the matter of minor details, such as cables, terminals, trolleys and gearing, the electric manufacturers have made the greatest improvements during the past eighteen months, but so far as we can obtain information based on actual facts, there has been but little improvement in the armatures. The Edison Company has recently announced a new armature, but we have been unable to learn what results it may show.

The switch box, such as used by the Sprague-Edison and Westinghouse, is an apparatus that if given proper care so as to keep the brass plates and buttons smooth, ought not cause much trouble. It is arranged so as to distribute the current through differ-

1. Read before the American Street Railway Association, Buffalo, N. Y. Oct. 15, 1890.

ent parts of the magnets or the motor according to the degree of speed or work required. It is somewhat in the way of passengers when the platform is overcrowded. The rheostat used by the Thomson-Houston Co. is out of the way, being underneath the platform, although it is burnt out occasionally and damaged by rain leaking through the platform; these defects should be easily overcome. It is claimed that owing to the use of the rheostat of the Thomson-Houston Co. and the resistance coils as used by the Westinghouse Co. that the cars start much more easily and without jerking, and that the motor is less liable to burn out, as they avoid throwing in an excess of current. The first claim is true, but we cannot find evidence to support the latter claim. On the other hand, it has been claimed that motors using a rheostat require on an average run from 15 to 20 per cent. more power than the Sprague-Edison motor. It does not necessarily follow that this is due to the rheostat; it seems likely that it is due as much to a difference in the winding of armature or fields. It would be most desirable, therefore, to ascertain from our various members the actual number of burn-outs of fields and armatures, of both varieties of motors, and at the same time the average power used per car. This cannot be obtained by writing for reports, as many roads do not keep an exact record or will not report the same. The grades of roads must be considered, the car mileage, and loads carried, also the system or manner with which motors are repaired and cared for.

This is a matter of the greatest importance. Our fuel costs about $1 per car per diem, and our repairs over $1.50 per car per diem. If we can save 10 per cent. on fuel each day by giving up the rheostat we do not want to do it at the expense of adding 25 per cent. to our repair account, which we all know is too large already. As an example of the approximate cost of repairs I give the cost of four 30 h. p. Sprague cars for the six months ending October 1, 1890, each car making 90 miles a day, a grade 1,900 feet of 9 to 9¾ per cent., one 300 feet of 5 per cent., one 300 feet of 8 per cent.

MECHANICAL.

3 bronze intermediate pinion at $14	$42 00
3 steel intermediate pinion at $9	27 00
8 steel armature pinion at $7	56 00
4 intermediate gear at $11	44 00
2 main gear (axle) at $16	32 00
6 axle brasses at $4.50	27 00
8 shaft bearings at $4.50	36 00
12 armature bearings at $2.75	32 00
	$296 00

ELECTRICAL.

180 carbon brushes at 10 cents	$18 00
6 trolley wheels at $1.25	7 50
3 field magnets at $20	60 00
6 armatures repaired at $35	210 00
	$295 50

For labor—

2 motor repair men at $50 per month	600 00
Total	$1,191 50

Average per diem per car, $1.62.

There are other minor repairs that would increase this about 20 cents a day.

Fuel, saw-dust and slabs, $1.30.

This fuel is about equal to screening or slack at $1.50 a ton; a greater number of cars would reduce this fuel account per car. During the six months the expense on the overhead line was less than $25 on five miles of line.

We have learned of an eight-car road running at $1 per car for fuel, another six-car road at 90 cents per diem per car. We do not believe in any case that the fuel will equal the cost of motor repairs. The first year of operation must not be taken as a fair estimate. The prices for gear and bearing will vary considerably from those given above. Some axle brasses cost $9, while those above are given at $4.50. Aluminum or some such compound may be mixed and used to decrease the cost and increase the durability of bearings; it was sold a few years ago at $3 and upwards per pound, now at $1, and it is stated can be produced for twenty cents per pound.

In the matter of gear the Westinghouse Company has so boxed the same that it can run in oil and grease; this must undoubtedly add much to the life of the gear and pinion and at the same time practically deaden the noise. Whether this boxing will stand the wear and jar, time will best demonstrate.

The following report of a road operating Thomson-Houston motors is most valuable in showing the proportion of cars disabled from electrical and mechanical causes during fourteen consecutive days in July, 1890:—

Equipped.	Operated.	Disabled.	
		Electrically.	Mechanically.
286	150 to 200		
"	"	0	15
"	"	0	12
"	"	2	12
"	"	5	8
"	"	0	11
"	"	3	11
"	"	3	9
"	"	1	10
"	"	5	7
"	"	2	11
"	"	2	15
"	"	2	13
"	"	1	12
"	"	0	12
		26	158

In seven consecutive days in August:—

Equipped.	Operated.	Disabled.	
		Electrically.	Mechanically.
308	150	3	10
"	"	5	11
"	"	0	9
"	"	4	7
"	"	0	5
"	"	4	5
"	"	1	8
		17	55

During seven consecutive days in September:—

Equipped.	Operated.	Disabled.	
		Electrically.	Mechanically.
312	150	2	3
"	"	5	3
"	"	3	2
"	"	3	3
"	"	0	5
"	"	1	4
"	"	1	4
		15	24

From this it appears that in July about 1 per cent. of the cars operated were disabled each day from electrical causes and about 6 per cent. from mechanical causes, and this during a period of extraordinarily heavy business.

During the August period the electrical trouble appears to have increased slightly in excess of 1 per cent. and the mechanical decreased to about 5 per cent., and in September the mechanical trouble decreased to about 2 per cent. This decrease was probably due in some degree to a lighter business and less mileage. As the report does not state the nature or degree of the electrical disabilities, it is not fair to assume that they were all due to crippled armatures, but we can deduce from it that a car ought to run 100 days without electric repairs.

NEW YORK SUBWAY RENTALS.

The Consolidated Subway Company notified all of the electric light companies in New York City to pay before October 17, the rentals already due and overdue for duct space in the New York subways; and that in the event of their failure to pay these rentals or a portion of them, the Subway Company would either cut their wires and cables or remove them, or both. The companies have in the meantime protected themselves by an injunction from Judge Barrett, of the New York State Supreme Court.

PUBLIC AND STATE TREATMENT OF CORPORATIONS.[1]

BY G. HILTON SCRIBNER.

A YEAR ago when it was my pleasure by reason of appointment, to present a paper before this Association upon this topic, attention was called to many of the unjust burdens imposed upon corporations by the public and the State, and so this paper may prove, although written from a different point of view, a repetition in part of the conclusions then reached.

But the ill treatment of corporations is also repeated with every session of legislature and courts, with each issue of press and political platform, and therefore continual protest upon our part, though that protest shall often rehearse the story of kindred and like wrongs inflicted and borne before, cannot be amiss.

Petition and protest, patient and persistent, has often secured a hearing and effected a removal of undeserved political and social disabilities, and so to review again some of the facts and considerations which in substance have already been considered, can do no harm. But aside from the fact that it is our duty always to complain in indignant and yet dignified terms against unjust and iniquitous treatment at the hands of the public and State, it certainly should be a matter of anxious thought and investigation on our part to discover toward what result the present trend of public opinion and usage of corporations are leading and what is likely to be the end so far as the control and use of their property is concerned, unless a change of sentiment and action regarding them is affected.

It is no longer a contention with intelligent people whether corporations are required to pay higher taxes and bear more public burdens in proportion to their property or to the protection and benefits received than private individuals. It is no longer a debatable issue with any class of persons, intelligent or otherwise, that in a dispute between a corporation and an individual before a jury the corporation without regard to the merits of the case is bound to be beaten if the court does not interfere for its protection.

No one can longer doubt that before congress, the State legislatures and even more conspicuously, before the local authorities of municipalities, all corporations not only stand at a disadvantage in securing that legal protection which the individual may obtain without asking, but they are more than ever before in constant danger of being preyed upon in every conceivable way by these legal guardians of the public weal, under whose exactments every corporation has at some time and in some way come into existence.

No man of observation and experience will longer deny that to be prominently and officially connected with corporations, either in ownership or management, constitutes a constant and strong element of ineligibility on the part of any otherwise fit man for elective public office. Now, nothing can be more evident upon a moment's reflection, than that corporations of all kinds are but associations of a number of citizens to do what cannot so well be done by one, or a small number of persons, and that the State in all cases, has been the earliest discoverer of the utility of these associations, and the promoter of these combined efforts in all those departments of industrial economy in which they have been authorized to act and into which they have been by the state first invited.

It is undoubtedly true that even in this age of the world and under the most potent influences of our best civilizations, selfishness still remains a stronger impulse and motive than a sense of justice with that majority of the people which in this country have the right to rule. It is, therefore, quite useless to appeal to the sense of justice of either the courts, the legislatures, the press or the public in pleading the cause of corporate rights or in any attempt to relieve those whose property and industry are involved in corporate undertakings, from the injustice and imposition which is constantly and everywhere inflicted upon them.

So long as those large classes which embrace in their combined membership all the learned professions, also the agriculturists, the artizans, trades people, all wage earners, and indeed all who live by industrial work and enterprise (who constitute the majority in almost every community) believe that the interests and welfare of individuals and classes may be promoted by preying upon corporations, so long will those who live by corporate industries and investments suffer all the undeserved ills of unequal taxation and legislative injustice which are now being visited upon them.

If the fact were clearly demonstrable that it is no more detrimental for those whose industry and capital are invested in corporate undertakings to be thrifty and prosper, or even to become wealthy, than it would be for them to reach the same condition by individual effort, then of course the classes above referred to might perhaps in time be made to see that they were not, after all, conserving their own best interest by indulging in so much prejudice against corporations or allowing their cupidity with so slight an admixture of justice or a sense of right to characterize and control their dealings with them. It is true that these classes, whose interests in corporations is really and only parasitical, always provide themselves with what they hold to be fit excuses for their views and conduct.

One of the most common and at the same time fallacious excuses for placing inordinate burdens and restrictions upon corporations is the allegation that the corporation enjoys valuable franchises and exceptional chartered privileges, for which it has given no adequate consideration. That it has a wide scope of some kind of authority, and at the same time little or no competition; in other words, that it is a monopoly clothed with unusual powers taken from the people—all of these assumptions are unfounded and false.

Let us for a moment examine one of the most frequent charges, indeed it is about the only charge, which those who are prejudiced against corporations put forward to fortify others and justify themselves in their depredations upon them. It is claimed, for instance, that railroad companies exercise the right of eminent domain in establishing and securing their rights of way under the proceedings for the condemnation of land. Now, nothing could be further from the truth. In the first place, the State itself, under its own organic law or constitution, can only exercise the right of eminent domain against the vested rights of any citizen when it is found to be necessary to take private property for public uses. But public uses are necessarily its own uses—neither more nor less.

The State is the organized public. Moreover, private property cannot be taken by the State even for its own public uses except by giving a full compensation therefor. In the case of railroad corporations and all others where the right of eminent domain is exercised, the State takes the land for its own advantage while the corporation pays for it, and in return only receives an easement or right to use it for certain specified purposes. The railroad company loses even this limited claim upon it when it ceases to so use it, and it reverts without payment to the original owner of the fee. So in no sense does the railroad company exercise the right of eminent domain. The State, on the contrary, does exercise it for its own benefit and purposes, while the company pays whatever the State shall determine to the owners whose occupancy has been thus disturbed by the State itself for the necessities of the public.

The courts have held, it is true, that in the case of quasi public corporations the company is in some sense the agent of the State in the taking of land and in exercising some of its other functions; but this is a confession, so far as it goes, that the State is the principal in all cases and is in perfect accord with the doctrine here urged, that in all cases where the right of eminent domain is exercised, it is exercised by the State, and in the interest of the public and in no sense and to no extent in the interest of the corporation as such.

The only act which the company does which would have the semblance of actual ownership in the premises is that it pays the owner the full value of an absolute title in fee for that which the State has taken in its own behalf, while in return the company only acquires an easement, and that forever after the company pays taxes upon the same annually at an assessed valuation much higher than is assessed upon any other land in the neighborhood which is still held in fee. What is true of steam railroad companies in this respect is also true of street railroad companies.

No street railroad company acquires any property in the street itself, but only a right to use the street in a manner which, in the opinion of the Legislature, will best conserve the interests of the public, which is in fact the State. In other words, the company simply acquires the right to use the street for that particular purpose, and no other, for which in the judgment of the State the street was originally opened and dedicated.

This is a right which the individuals composing the public have without special permission and thus which belongs to the whole public. So when the organized public or State authorizes a certain number of its members to lay down railroad tracks in the public streets, for the transportation of passengers, at a fixed rate of fare and under many restrictions and special obligations, all duly set forth as conditions precedent to the occupation of the streets, and the operation of the railroad therein, it is only fair and reasonable to suppose that the public, or State, has consulted only its own interests in making the proposition, and likewise that those individuals constituting the company in accepting the offer, have been moved to do so by a similar motive. It is therefore not only sheer nonsense but unfair and even positively dishonest on the part of the public, or State, to demand of the company afterwards anything not named in the charter, or to impose any new burden upon the company, upon the ground that the public has parted with something which it once owned, when neither as matter of fact or law has it parted with anything whatever, and would not be justified in breaking its bargains even if it had parted with something extremely valuable.

In no civilized country could any individual, under the laws and usages thereof, so deal with another. It has been reserved to the American people under republican form of government to "Eat its cake and keep it too," in dealing with those modern associations of industry and capital called corporations, and which have done more, by the way, to develop the resources of the country than all other causes combined. In all the multiplicity of de-

1. A paper read before the American Street Railway Association, Buffalo, N. Y., October 16, 1890.

fenses of the individual, both as to personal and proprietary rights embodied in the constitution of the State of New York, there is not one word of command or suggestion that taxes should be equal or uniform. The Legislature may, if it chooses, under and by authority of the constitution, place the entire burden of the State, and even of counties, towns and municipalities, upon those whose property is managed by corporations. It must be a very careless observer of the drift of public opinion and of legislative policy for the last few years who has not discovered that this very thing is now in course of accomplishment.

As before stated, the specious and unfounded excuse for this condition of things put forth daily by the press and thoroughly believed in by the general public, is that corporations of all kinds enjoy special privileges which place them under eternal obligations to the State and to the public, in other words, under a never ending obligation to everyone who is not interested in them except in this parasitical way.

Let us examine for a moment and see, if possible, whether there is any truth whatever in this pretended excuse which, if it were sound in fact, would not, as has been shown, justify the State or public, under any circumstances, in dealing with corporate property or the persons who own it on any different basis from that assumed in dealing with individuals and their interests. Remember that the question is, whether corporations enjoy by virtue of law any exceptional privileges? To bring to a focus at once all the factors and considerations bearing upon the solution of this question without a long argument backed by a still more tedious recital of examples and details, let us ask whether corporations would gain or lose by the enactment of a law declaring that the scope of all corporate rights and liabilities shall hereafter be extended and restricted to whatever citizens may legally do.

Such a law would give to the corporation the right to hold whatever property it chose to acquire, and to have it treated and taxed by the State as individual property is treated and taxed. It would give the corporation the right to conduct its business affairs without inspection or supervision. It would give it the right to engage in any industry it chose and to carry it on wherever it should find it most convenient to do so. It would give it the right to keep its own affairs to itself instead of spreading them upon public records and publishing a great part of them in the public newspapers. It would give the corporation the right to make its business as profitable, without question, as thousands of able business men have made theirs, to say nothing of the right to vote, hold office and be represented in the Legislature.

There are hundreds of limitations beside, hedging the actions of the corporation on every hand to which the private citizen is an absolute stranger in his business life.

It is true that citizens as such cannot under existing law issue money nor secure by law an easement for the purpose of railroading. But all citizens who choose may at any time and anywhere do these and all other things which any corporation may do by combining pursuant to general laws, their efforts and capital for such purposes.

There is but one great monopoly either in property or authority in this country and this is the privilege and franchise of those who have no invested interests in corporations and who constitute the majority to tax the property and restrict the actions of those whose property is employed through corporations without limit and thus protect their own lands and goods from public burdens and their own business from competition by this unjust imposition upon the property and business of others.

In several States corporate property now pays the entire State tax, leaving all other property free and clear of this great annual burden.

In all the States corporate property is excessively and unjustly taxed, and the business and affairs of all corporations are subjected to visitation, inspection and restriction by State and municipal authority in a manner and to an extent which is unfair in most cases, and in others simply outrageous.

It is not true then in any sense that a corporation is an association of persons enjoying exceptional privileges and exemptions as compared with individuals; on the contrary, it is an association authorized by law for some specific purpose which has been recognized and approved by the State, but with abridged rights, limited scope, restrained activities and increased liabilities and control, as compared with those of the citizen.

What reason, or justice, or decency is there then in maintaining two systems of taxation, one for corporate and another for individual property?

When a corporation has paid taxes at the current percentage for the year upon all its real and stands ready to pay upon all its personal estate, why should its capital stock be assessed and taxed? Why should it pay still other license fees and assessments, and additional taxes based upon its earnings gross and net. By this unjust method of stock assessment, the railroad company is compelled to pay an annual tax upon the good will or prospects of its business and which is assessed usually at three or four times the value of all the personal property it owns. One instance is as good as another in showing to what extent street railroad companies are imposed upon in this matter of taxation. The rate for the last year in the city of New York for city, county and State tax on personal property was 1.686, or a little less than 1¾ per cent. Not one person in a hundred liable for personal taxes, paid even at this low rate, anything whatever, and the hundredth one, it is safe to say, did not pay on one-hundredth part of his personal estate. Now one street railroad company owning but $344,000 of personal estate all told, paid beside its real estate tax $38,000, which is a little more than eleven per cent. in one year upon its entire personal property, not estimated at a low valuation, but computed at cost, without any allowance for wear and depreciation. All other companies in New York paid at about the same rate without any deduction for indebtedness, bonded or otherwise.

Why should a hundred or more bills be introduced at each session of the State Legislature, all intended to the best of the ability and ingenuity of their authors to injure or annoy corporations in the transaction of their business beside those intended to shift additional burdens from individual to corporate property, the first of which are never criticised by the public or the press, while the latter are always greeted with commendation and applause.

Before courts and juries, corporations in dispute with a citizen have come to be dealt with so unjustly that as a rule they find it less oppressive to appeal to their adversaries and abide by their judgment, stimulated and warped as it must be by cupidity, than to go before these tribunals of professed impartiality. During the last year a case for a trifling injury to the person was tried in the Superior Court of the City of New York in which the corporation with which the writer is connected was the defendant. The jury seemed intelligent, the judge ruled fairly, and the case was on both sides well presented. To the astonishment of both parties, the jury, after a short deliberation, brought in a verdict for $5,000, which, however, was settled the next day for $2,000—all parties concerned well knowing that in this case, at least, the jury had committed an act under the forms of law for which every one of them should have been fined the full amount of the verdict, had they had lacked the legal protection of jurors or acted from a less excusable motive than unfounded prejudice.

This course of treatment of corporations by the public and the press, the Legislature and the courts can in the nature of things have but one ending if continued long enough.

Corporations will at last, one and all, surrender or sell to the State upon such terms as a venal Legislature may offer, the various industries which can no longer with profit be carried on in opposition to its interferences and under the increasing burdens and oppressions which by striking bills and otherwise it has placed upon them.

It is even now the constant appeal of all labor unions, that the State shall take not only into its control but ownership, all quasi public corporations. Nor is their course in this respect illogical, for public ownership and management would not only open to them the most direct avenue to corporatate property and earnings, but it would prove a long stride toward the distribution of all wealth, and render the dream of the Socialist a possibility.

Our free schools, free press, and that exhaustive discussion of all public questions preceding the frequent elections under a democratic form of government, has at last taught all classes, including laborers, in this country what their material interests are. They are fully instructed not only as to their physical wants, but how to supply them.

Now large numbers of persons bound together by avocations and associations, and which we call classes, have always without exception, in all countries and in all ages since the dawn of history, regarded their wants and their rights as synonymous, and such will be the rule in the present case.

To-day the world over, and in this country more than any other, labor and capital, the former willingly and the latter under the lash, are on a dead run for the same goal. And this goal—this consummation, ignore it as we may—call it what we will—disguise it as we please—is no other, in fact, than absolute State management—and State management is neither more nor less than State socialism of the German type.

To-day a very simple and evident truth is flashed over the Vanderbilt system, that "to be a Knight of Labor is inconsistent with the duty of a railroad employè," and the chosen chieftain of the laborer screams back from Scranton, "to-morrow the government shall own and manage all your corporations." Here you have the very gist of the labor question. In its last analysis, it is a question of control. This, and this only, is in dispute between labor and capital. It is an "irrepressible conflict" between two great classes as to which shall possess and control what labor has produced, and is producing. Now if anyone can tell which is the most numerous class—those who have control, or those who want it—the ins or the outs in ownership, it will not be difficult to determine which class, stimulated by eager politicians, will ultimately carry the elections and control the government.

Conservatism, it is true, usually comes with responsibility, but it is only a conservatism in dealing with the disputes of others after self interest has been fully satisfied.

Whatever may be said against Mr. Powderly's proposition, that a government, to be controlled by him and his followers, and which by that time will be his and their government, shall seize the corporations for their own benefit, it must be admitted that

he is simply and only following to its logical conclusion the theory and practice which the present government has already inaugorated, that of treating the property belonging to one class of citizens differently from that belonging to another. Those who think themselves Mr. Powderly's betters in morals and in many other ways, say boldly, let us prey upon corporate earnings by every means in our power, and Powderly says, let us seize the entire plant and so take all their earnings.

The doctrines proclaimed by the press, the pulpit and the bar, taught in the counting house, the shop and the field, enacted by the Legislature, enforced by the court and confirmed by the jury, is that corporate earnings may be seized and taken by unjust and unequal assessments, taxes and judgments, and in many other ways, simply because they are corporate earnings, for the comfort, uses and relief of those who have no proprietary interest in them. Now to do this, is not one whit more commendable than to follow Mr. Powderly to the logical consummation he announces, that of taking the whole, while it is much meaner than his method, as petty larceny is more contemptible than grand. It is, besides, more aggravating.

Those who maintain the right of legal forage upon property not their own through unequal taxation, interference and restrictions, not only violate their own professions, but seek flimsy excuses for their course and try to shut their own eyes to the fact that they are constantly doing in a retail way what Mr. Powderly proposes shall be done at wholesale.

Is it to be supposed that either class will succeed in a peaceful and lasting transfer from other pockets to their own without compensation? Can such systems be firmly established and maintained in America and revolution avoided? There is not the slightest probability of it.

The age has past (if there ever was one), when injustice and oppression in any form can be systematically practiced by one large class of society upon another of the same race, with any result but that of final disaster and ruin to those who expect to profit by it.

When corporations are taken by the State, no one else will want them on the same terms, and the Carnival of the public, while in possession, will be brief and unsatisfactory.

It is an unpleasant task to sound a note of warning, and generally an unwelcome one, but he lacks sagacity, no less than courage, who seeks to hide an evident future or hesitates to look any unpleasant prospect in the face.

It is possible that a fortunate and timely change in public views and sentiments may yet turn back the tide of confiscation and distribution, which has been already begun.

It is possible that statutes may he repealed, ordinances rescinded, and decisions reversed, so that the property of one class shall no longer be seized upon for the benefit of another, but is it probable?

He must be an optimist indeed, who can discover in the present attitude of the Legislature or the courts, the press or the public, anything which is prophetic of such a just and desirable consummation.

SPIRAL OR TRANSITION CURVES FOR STREET RAILWAYS OPERATED BY MECHANICAL MOTORS.[1]

BY E. A. WOOLLEY, LINCOLN, NEB.

In ordinary railroad practice spiral curves are, in theory, no new thing, although even in this field they have never received the attention which the importance of the subject demands.

I feel safe in making the assertion that there is no road in the country where they have been introduced that would now think of building a railway, involving what might be considered even moderately sharp curvature, without the use of spirals.

In the construction of street railways, we are obliged to use curves very much sharper than the engineer of an ordinary railroad is ever called upon to contend with. At the same time our rolling stock is comparatively little better adapted for traversing sharp curves. So long as street cars were operated by animal power only, the speed was necessarily slow and the need of transition curves but little felt. With the introduction of mechanical motors the weight of our rolling stock is immensely increased, and at the same time the maximum speed is probably three times greater than with the old system of horse power. The practice of running cars in trains immensely increases the difficulty, so that now the blow given by the leading outer wheel as it first strikes the outer rail at the entrance of the curve is probably ten times greater than with the horse car.

So long as circular curves only are used, there is but one way of reducing the shock to passengers and cars and the constant danger of derailment at these points, and that is, to reduce the speed of the train. In the crowded business streets of a great city this reduction of speed is perhaps no disadvantage.

There are, however, many places in the suburbs and outlying districts where a reduction of speed would not be necessary but for the presence of the curve. It is in such places as these that the spiral will have the greatest advantage, although even at slow speed the passage of a sharp curve properly "spiralized" will be found infinitely smoother and better in every way.

In the practical application of the spiral to street car curves I have not as yet been able to give it as thorough a test as I could wish. However, I have done something in this direction. During last March, while in the employ of the Denver and Berkeley Park Rapid Transit Company, at Denver, Col., I laid out a curve of one hundred and forty feet radius, using spirals 100 feet long. The line was built to a three feet, six inch gauge and operated with Baldwin steam motors, weighing about 32,000 lbs., with trains of from one to three eight-wheeled cars, each thirty feet long. This was my first experience with a sharp curve spiralized. The first train to pass this curve was sent round at a speed of ten miles per hour. No jar whatever was felt upon entering the curve. Afterwards it was tried at higher speeds, until finally, as a test, an engine was sent round this curve at twenty-five miles per hour, and still there was no sign of shock or jar when entering or leaving the curve. This line had previously been in operation something over one year, and a great many passengers were in the habit of locating the point where they wished to leave the train when coming home at night by passing this curve. After the spiral curve was put in, dozens were carried by their stopping-place on account of the trains passing the curve so smoothly that sitting in their seats they did not notice it. Afterwards I made another test with a curve of seventy feet radius, with results proportionately good. As yet I have had no opportunity of testing the advantages of the spiral on curves of forty and fifty feet radius, but I firmly believe that by using spiral transition curves we may double the speed in passing any given curve without increasing the danger of derailment, and with much less strain or shock to cars and motors.

In regard to the methods of laying out these curves, I use a method in some respects different from any one else, so far as I know, but the methods of Wellington, Searle, or Henck may be used. Either will give satisfactory results. Perhaps the best method as yet published may be found in a pamphlet, *The Railroad Spiral*, by Prof. D. M. Greene, of the Rensselaer Polytechnic Institute, of Troy, N. Y.

It will matter but little what method is used. But care should be taken to lay out the spirals accurately, and in laying track, rails should be curved very carefully, If points are set on spiral from five to ten feet apart the trackmen can stretch a line of one rail length along spiral and take ordinates for curving rails directly from the stakes.

THE EDCO STORAGE BATTERY STREET CAR.[1]

BY D. H. BATES.

The horse is a noble and extremely useful animal, but he seldom combines high speed with great endurance. The fast trotter is made to run his mile in from two and a quarter to three minutes, but he does it only on rare occasions and is well fed and cared for between times.

It was not until yesterday, when Mr. Odell's very interesting paper was read, that I had any idea of the innumerable obstacles to be surmounted in first securing a perfect street car horse, and second, in maintaining him in a constantly efficient condition.

Judging from the expressions of a large number of street car men with whom I have talked on the subject of storage battery cars, I have inferred that your street car horse was ready for continuous hard work at all hours of the day or night. That it took no time to change horses at the end of a trip, and that you only fed them at night, after a sixty mile run, and that oats and hay were always cheap.

For all these or like requirements must be met with in our storage batteries, if they are to satisfy the average street car official.

But when we undertake to show that the energy requisite to propel a sixteen foot car with its average load of passengers at the horse car rate speed must be increased 100 per cent. if the speed be doubled, and that the cost of producing that increased energy, by whatever means you employ, must necessarily be doubled, the scientific fact is perhaps admitted, but if storage batteries are the medium it is always taken for granted that they ought to do double the service at half the cost.

The overhead systems in operation throughout the country have demonstrated to you, gentlemen, the fact that electricity is not the coming power, but the power already come. The mileage of street roads in the United States which in June, 1890, were operated electrically is, according to the eleventh census, $8\frac{4}{100}$ per cent. of the entire mileage, but omitting 59 cities the proportion runs up to 25 per cent. This means one of two things, either that as a rule the authorities of our large cities will not allow overhead poles in the street, or that street car managers prefer to await the

1. A paper read before the American Street Railway Association, Buffalo, N. Y., October 16, 1890.

1. An address delivered before the American Street Railway Association, Buffalo, N. Y., October 16, 1890.

result from the use of the electric system on a small scale in the towns and smaller cities before introducing it in the cities on a scale of greater magnitude.

The overhead systems already introduced in many places have so far improved upon the horse and mule that the public, once given rapid transit, would not go back to slower methods and are clamoring everywhere for such facilities.

You street car owners and representatives, however, must look at the resultant in the matter of cost per car mile and net profits, and before some of you yield to the loud demands of the public for rapid transit by adopting the overhead system we beg of you to carefully consider the merits of the storage battery.

1. It will propel a car just as fast and just as efficientiy with all that that implies as the trolley system. Every word that can be said in favor of the trolley system applies equally to the storage battery.

A storage battery car is capable of much work that a trolley car cannot accomplish.

a. Storage battery cars can be introduced gradually, one or two at a time, in connection with horse cars, cable cars or trolley cars.

We have already had proposals from a cable road for a few cars to be run at night when the cable could only run at a great proportionate expense, and from a trolley road where an extension was needed on a route that did not permit of trolley poles.

b. Storage battery cars can be run over any track or route where a horse car can be run, thus avoiding blocks in cases of fire, processions and other obstructions.

Transfers of cars can, with this system, be made from one road or route to another in cases of necessity or convenience in handling an unusual traffic.

c. In cases of break down at power station during hours of heavy traffic storage battery cars could run for two or three hours with the 33⅓ per cent. reserve always remaining in the double sets of batteries.

Now, as to the figures relating to the battery system.

What is the cost of a storage battery car plant?

What does it cost per car mile to maintain?

What does it cost per car mile to operate?

Let us take a unit of 50 cars: Fifty cars at $1,000, $50,000; storage plant engine, nominally 500 h. p. (triple expansion), $12,-500; 500 nominal h. p. boilers 50 per cent. margin, $10,000; 50 sets of car motor equipments, each consisting of two 15 h. p. slow speed motors capable of being exerted up to 20 h. p. each for brief periods with dust tight covers, gearing and motors running in oil starting, regulating, reversing and speed, switches, lamps, signals, batteries, etc., complete, $249,400.

Central station equipment, including dynamos, rheostats, switches, reserve batteries, shifting appliances, etc., complete, $128,400. Grand total, $450,300—say $9,000 per car for everything except buildings, road bed and tracks.

MAINTENANCE PER ANNUM.

Steam plant, 10 per cent	$2,250 00
Cars, 10 per cent	5,000 00
Electric plant exclusive of batteries, 10 per cent	21,500 00
Batteries, 20 per cent	31,680 00
Shifting appliances, 5 per cent	200 00
Total maintenance per annum	$60,630 00
Maintenance per car per annum	$1,212 00
Maintenance per car day	3 32

Maintenance per car mile (on basis of 120 miles per day), 2¾ cents. With a smaller run the wear and tear would, of course, be reduced.

DATA RE POWER PLANT AND COST.

Horse power required	500
Time required for producing such power	18 hours
Total horse power hours	9,000 hours
Coal per horse power with triple expansion engine	2 pounds
Coal per day 18,000 lbs., or	9 short tons
Coal being estimated at $3	$27 00

LABOR.

One chief engineer	$4 00
Two assistants at $2.50	5 00
Two firemen at $2	4 00
Two assistants at $1.50	3 00
Six shifters at $1.50	9 00
One electrician	4 00
Two assistants at $2.50	5 00
One dynamo man	3 00
Total labor	$37 00

SUPPLIES.

Water per day	$5 00
Oil and waste	2 80
Appurtenances and miscellaneous	2 80
Total supplies	$10 60

RECAPITULATION AND SUMMARY.

Fuel per day	$27 00
Labor per day	37 00
Supplies per day	10 60
Total cost per day for operation	74 00
Cost per car day for operation	1 48
Cost per car mile for operation	$1\frac{4}{100}$
Cost of maintenance per car mile	$2\frac{75}{100}$
Total cost of maintenance and operation per car mile	$3\frac{99}{100}$

The following are some of the conditions fulfilled by this company with its storage battery cars.

1st. That each car will be delivered in first-class order with appliances for keeping it well under control, and for readily operating it with such skill as would be possessed by an intelligent car driver after suitable instruction.

2d. That each car will be run fifteen (15) miles an hour on a straight level and suitable track in good order when carrying fifty (50) passengers, or an equivalent weight not exceeding 6,000 pounds.

3d. That each car with the above load will ascend grades not exceeding three per cent., and not longer than 500 feet, at the rate of at least five miles an hour.

4th. That two sets of batteries per car shall be delivered, either of which when fully charged shall be capable of propelling a loaded car as above on a straight level and suitable track for a distance of sixty miles if required, when it shall be replaced by the reserve battery, which meanwhile shall have been fully charged. Each battery can be charged while its alternate is being used. As a matter of policy, we advise retaining one-third of the charge of the battery, as a reserve for emergencies.

5th. That the batteries when treated according to printed instructions, and their parts renewed as required, will remain in an efficient condition.

We have already touched upon some points of advantage in the storage battery traction over the trolley system. We will now refer to the inherent defects of the trolley system which do not pertain to storage traction.

1st. The disfigurements of streets by double lines of poles and trolley wires, with cobwebs at every curve.

2d. The frequent interruption of the entire system by a break down at the power station or in the feeder wires.

3d. The great and sudden fluctuations in the load which make such break-downs of the power plant extremely frequent, many such break-downs having already occurred. With trolley and cable lines, the extremes of no load and full load are reached suddenly from one to a dozen times every five minutes. This is not only destructive to the machinery (steam, electric and cable), but frequently causes a break-down of the whole line, involving heavy outlays for repairs, serious loss of revenue and dissatisfaction on the part of the public.

4th. Bad economy in the power station, due to the fact that maximum power must be provided in the engines and dynamos instead of the average power as provided in the storage system, causing the engines with the trolley system to run with an average of about half their load and therefore uneconomically; with storage battery traction the engines and dynamos run with an even and unfluctuating load continuously, giving the best possible economy of coal and increasing the life of the plant.

Economy and inconvenience of operation as compared with requiring an expenditure of energy in all portions of the line, even though but one or a few cars may be running. For suburban roads and all night runs this feature is of special importance.

6th. Liability of generators and motors being burned out by lightning passing through the bare trolley wires through the motors to the ground.

7th. Liability to motors burning out with the high voltage current.

8th. The business public is inconvenienced by the derangement of the telephone service due to induction and leakage from the trolley lines to such an extent as to make the telephone service useless and dangerous.

Last, and perhaps most important, at least to the general public, the trolley system requires a current of high potential conducted along bare wires extending over the entire route of the line, always liable to contact with electric light, telegraph, telephone, district messenger, fire alarm and police alarm wires, the system thus being a constant menace to life and property throughout the city. Contact with any foreign wire may lead to a conflagration such as destroyed immense values of property in Lynn and Boston within a year, and death to horses and human beings,

numerous instances of both having been frequently reported in the public prints.

Therefore we feel warranted in asking street car companies to give storage battery traction, which possesses none of these disadvantages, and involves none of these dangers, a fair trial under reasonable conditions, and under the supervision of men experienced in the various branches of engineering involved in the business, and who have had nine years' experience in the manufacture and use of storage batteries.

NINTH ANNUAL MEETING OF THE AMERICAN STREET RAILWAY ASSOCIATION, BUFFALO, N. Y., OCTOBER 15, 16, and 17, 1890.

The Association held its convention in the Buffalo Library building, beginning at 10:30 A. M., on Wednesday, the 15th, with President Thomas Lowry in the chair. The attendance throughout was extremely large, there being 400 to 500 gentlemen in attendance, including from 175 to 200 street railway men actively engaged in the field.

Mr. Lowry then spoke as follows :

PRESIDENT LOWRY'S ADDRESS.

I am pleased to meet you in this beautiful city of Buffalo, assembled in the Ninth Annual Convention of the American Street Railway Association.

I congratulate you on the progress made and past good work of the Association. When organized in 1882, in the city of Boston, street railroading was in its infancy, but much rapid advancement has since been made in city passenger traffic that the United States Government has deemed it of sufficient importance to incorporate in its Census Statistics, for 1890, a report on Street Railways in cities of over 50,000 inhabitants. In this report 56 cities are included, and out of a total of 3,150 miles of track in these cities,

2,851 miles are operated by horses,
260 miles by Electricity,
255 miles by Cable,
221 miles by Steam.

and the balance, about 60 miles, being the Elevated Roads in New York and Brooklyn. This report would seem to indicate that in the larger cities the faithful old horse is still the favorite propelling power for street cars.

The first special subject on which we are to receive a report from a committee appointed at the last Convention, is "A Perfect Street Railway Horse." From this we must assume that the Association has not yet discarded the idea that the horse is the most reliable power for street cars.

In the smaller cities electricity is generally being adopted, and I am informed that there are already in operation in cities and towns outside of those enumerated in the Census Report, about 1,600 miles of electric street railways. I am so thoroughly convinced that electricity is the coming power for street railways (except on heavy grades where the cable is best suited) and that it will prove so effective as a means of rapid transit for cities, that I believe this is the last Convention that will ever seriously consider horses for the operation of street railways.

Rapid transit in growing cities is becoming a necessity. While Municipal Corporations in the larger cities, for many reasons, are slow to grant new privileges to corporations, and in the case of electricity they are very closely scanned and criticised, it will soon become self-evident that a municipal body can grant no greater boon to its middle and laboring classes than to provide them with the means of rapid and cheap transportation to and from homes in the suburbs, where they can live under a clear sky and in a health-giving atmosphere. When the people of a city understand clearly the great benefits of rapid transit, by electricity or other improved motive power over horses, they will demand that their city authorities grant such rights as will enable street railway companies to operate by the most improved methods.

Heretofore street railway securities have not been looked upon by the financial world with favor. However, since they have been so successfully operated by electricity the financial men of the country are looking to its development and application to street railways as an additional reliable security for the investment of savings and trust funds. This should give encouragement to street railway companies to give their various cities the most improved and best possible service. They will not only please their patrons but the investment will prove very profitable. If street railway companies do this, no better security can be offered for the savings of the widow and orphan than a good street railway bond in a thriving city.

In order to bring this about, Municipal Corporations should grant liberal franchises for street railway improvement. The bond of the street railway company should be as good as the bond of the city in which it is located. The growth of the city is, to a large extent, dependent on street railway extensions, and the prosperity of the street railway company means the prosperity of the city in which it is located. It is one of the largest factors in the development of any city and as necessary as are its schools and its churches.

On the other hand the street railway company should be required to equip its road with the finest and most modern cars, construct the best and most substantial tracks so as to inconvenience the public as little as possible in making repairs, and, in short, supply the road in every department with the best and most modern appliances of all kinds.

In view of the agitation of the labor question, it may not be out of place for me to say a word on that subject. In so doing it will only be the expression of an individual opinion, not intended to bind the Convention to the views expressed. When organizations are formed by laborers and others for the purpose of building up and dignifying its members as men and women, or to improve their moral, physical or financial condition, no one would foster or favor them more than he who now addresses you. Unfortunately, however, most of the present so-called labor organizations are the worst delusion and snare into which a laboring man was ever entrapped. One recent "strike" on the New York Central road developed a state of cruelty, depravity and wrong that should make it the absolute duty of every corporation, having public interests to subserve and charged with providing for the comfort, convenience, business necessities, and above all the life and property of its patrons, to refuse to employ or retain in its employ any one who does not renounce his connection with the "Knights of Labor" or any other labor organization, the rules of which permit employés of a corporation to be "ordered to strike." Men have a right to quit work with such notice as the contract with their employers requires, either singly or in a body, if the terms of their employment are not satisfactory; but they have not the right to interfere with those employed to supply their places. The first duty of a lawyer is to his client, of a doctor to his patient, a minister to his congregation, and a teacher to his pupil. The engineer, the conductor, the switchmen have even a greater responsibility, as the lives of the passengers are in their keeping, and in order to properly discharge it they must be loyal to their employers. They cannot be plotting or laying out rules for their employer and be faithful in the discharge of their duty. "The laborer is worthy of his hire," but when he seeks to change the relation between himself and his employer, by asserting himself as master, he ceases to be the laborer that is "worthy of his hire." He also unfits himself for any kind of advancement. A man, to be successful and take advantage of promotion earned by efficiency, must be contented and perform his work cheerfully. A "labor agitator" cannot be contented or work in the interest of his employer. A few days ago United States Commissioner Rogers rendered a decision at Baltimore, in a case where four sailors were arrested for refusing to go aboard a schooner after they had signed articles to do so. The Knights of Labor interfered and undertook to defend the prisoners. I cannot express my views better on this question than to quote from the decision of Commissioner Rogers, who said :

"I perceive you are men of intelligence and no doubt know and appreciate the advantages of union. Every man has a perfect right to unite with his fellow man to better his condition in life. There is one great mistake made, however, and that is the constant conflict of labor and capital. Now, I can't see why such a state of affairs should exist, because labor is in itself capital, and capital merely represents labor. A capitalist you will find is a man of strictly sober habits. He has to keep a clear head, and the man who to-day earns a dollar and to-morrow morning wakes up with 75 cents in his pocket is the man who may become a capitalist. No doubt your union is a good thing—the land we live in is a union. But now let me impress upon your minds that, while you have a perfect right to form a union, you have no right to interfere with the manner in which another man conducts his business. When a union attempts to interfere with or molest a free-born American, or tries to prevent his earning a living simply because he does not join that union, it then becomes a conspiracy, and amenable under the law and punishable by the court. The great trouble with the unions is that they overstep their bounds and endeavor to force people to do as they direct, and that is an act in direct violation of the laws which grant an American citizen his liberty. In these days of enlightenment and freedom, the press—the most powerful agent of the people—is ever ready to air the grievances of anyone who is oppressed or molested. Nothing, from the great acts of a Government to the death of a pauper, escapes the eagle eye of the press. Tyrants fear the press more than any other power which can be brought to bear against them, and the press of America, as it is to-day, edited by men of the greatest and highest order of enlightenment, is the bulwark of the country. Now, in conclusion, let me say to you that the man who endeavors to persuade you to fight against capital, except in a legal manner, is no friend."

The following is an extract from the Report of the Executive Committee:

"The subject 'Electric Motive Power Technically Considered' was selected for the purpose of having the cobwebs, which were for the most part confessedly before our mind's eye, brushed away from this occult science in order that it might be as plainly comprehensible to the ordinary street railway man as to the expert who manipulates the wires."

The necessity for this knowledge is becoming greater as the days go by, for the transition of roads from horse to electric power is of almost daily occurrence, so rapid is the progress made by electricity as a motive power. In this connection we take occasion to say that the information which it is hoped will be freely given at this meeting concerning the cost of operation by electricity will, doubtless, still more rapidly hasten the emancipation of the horse from his bondage.

The Treasurer's Report was read, and showed the financial transactions during the year to be as follows:

Receipts	$7,165.91
Expenses	5,389.96
Balance on hand.	$1,775.95

No report was offered on cable work, Mr. J. C. Robinson, to whom the subject had been assigned, asking for a year's delay in its presentation.

The next paper was that of Dr. W. L. Allen on "Electric Motive Power, Technically Considered."[1]

This paper among other topics was discussed in executive session on Wednesday evening. The subject was taken up again on Thursday morning, when those present representing electric systems were invited to make statements as to their respective systems and devices.

MR. D. H. BATES, of the Electrical Accumulator Co. made an address on the Edco car.[2] He added that the figures were based on 10,000 miles operation with 3 cars. He mentioned that Dubuque was equipping a road with 8 of their storage cars, the success attained there with the cars now running having led to the larger contract.

MR. CHADBOURNE, of Chadbourne & Hazelton, representing the Wenstrom system, then made a neat and effective extemporaneous address as to their street car work. They have a road equipping in Pennsylvania, which will be running in a few days. He touched on the various points of their well known motor, alluding particularly to the features of slow speed, the dispensing with the intermediate shaft in the gear, the use of their wooden toothed gears, and the continuous running of the armature as effected with the help of the "hydraulic valve gear," described for the first time in this issue of THE ELECTRICAL ENGINEER.[3] Mr. Chadbourne claimed a reduction of half the machinery under the car, and a saving of not less than 10 per cent. in power consumed. As to the wooden gears, he cited the testimony of Mr. Harrington, of the Atlantic City, N. J., road, as to their superior efficiency and lasting qualities.

MR. MALONE WHELESS followed with a brief and pithy description of his electric railway conduit system as operated in Washington, the only and full description of which appeared in THE ELECTRICAL ENGINEER of Sept. 24. He touched rapidly on the principles of operation, including that of energizing only the section of the conduit over which the car is running, and it was evident when he closed that a most favorable impression had been made.

MR. KNIGHT NEFTEL, of the United Electric Traction Company, of New York, said:

It is unnecessary for me to say anything regarding the value of storage battery traction, after the very apt remarks made by my friend of the Accumulator Company. I will simply give concisely our results in operating ten storage battery cars on the Madison Avenue Line in New York.

The equipment of each car consists of 108 Julien cells in 12 trays, nine cells in each, total weight, 3,600 pounds. The motors in use, until recently, and on the old cars now running, are of the Thomson-Houston type. We have now constructed a motor especially adapted to this class of work, and which is now being put on this line. An estimate of cost of operating has been submitted to you by another company, based on the performance of 50 cars. Our experience with ten cars in actual operation over an extended period, which, by the way, is the largest storage plant in this country, and next to the largest in the world, is as follows:

Generating plant, 8 horse-power per car. For ten cars 15 batteries are necessary. Rate at which each battery is charged, one and one-half hours, for two hours discharge. One charge is adequate for a run of 40 miles on a level track. With the old cells and the old type of motor, these ten cars were operated at 10.6 cents per car mile; with the improved batteries and the new type of motor, the life of the existing plants of the battery, at the present rate of disintegration, is at least three years. The negative plates, the other half of the battery, are as durable as the motor. It is generally conceded that the reason storage batteries have not been applied more extensively is the lack of confidence in the endurance of the batteries and litigation on patents.

We are prepared to demonstrate to you practically the life of the batteries, and the question of patents has been greatly cleared by the final decree giving Charles F. Brush, of Cleveland, a fundamental award of priority.

Our batteries are manufactured under the patents of Brush, Julien, Morris, Salom and others. We are now equipping a road in Indianapolis, Ind., on this system. Our company also furnishes overhead equipments, and we shall be pleased to have any member of the Convention visit the plant at Madison avenue and other roads equipped by us.

Mr. Graham, of Baltimore: Can you tell me the number of miles per day each car runs?

Mr. Neftel: Eighty. The maximum grade is about 5½ or 6 per cent.; there is a very severe grade for a short distance on one part of the road, between Seventy-second and Seventieth streets, going down.

Mr. Graham: What is the length of the grade?

Mr. Neftel: About two blocks.

Mr. Graham: Do you ever run on a grade higher than five and a half per cent.?

Mr. Neftel: Yes, sir; there is one grade which is seven and a half per cent. The motors will go up that, but, of course, it discharges the batteries very rapidly when you subject them to such heavy work.

Mr. Graham: Is the car capable of ascending any usual grade, say 10 per cent.?

Mr. Neftel: Yes, sir; it is simply a question of discharging the batteries.

Mr. Henry: When you say 10 cents per car mile, what is included?

Mr. Neftel: Everything, except the conductors and drivers. Of course, there is a reasonable amount for the repairs of the motors.

The Convention then adjourned till 2:30 p. m., when the subject was resumed by MR. E. E. HIGGINS, of the Edison General Electric Co., who made a very fine showing for the familiar work of that company and went into the details of construction. He spoke principally of the improvements that had lately been effected in the construction of the trolley, and the method of securing it to the car, and the improvements effected in the motors. He said:

"In the new apparatus that we are bringing out, we have made some very notable advances. In the first place, our armatures are wound upon an entirely new plan—one which we think is a distinct advance. In the old style what is known as the Siemens winding is employed; the wires are wound on the core and carried around at the end and form a conical shaped bundle, which gives a chance for play and abrasion; and this means short circuits and burn-outs. With the new armatures we have a new standard coil, some 60 of which go on to the core. They are so formed that the rear of the armature, and front alike, give no chance for motion. They are brought firmly in place, and you have a diameter of armature which is always the same, because the coils are standard. With this system burn-outs will be extremely rare. We do not claim that there will not be any; but we believe in the regular daily workings of the car, with proper management, nothing ordinary will burn out the machine except dead overloading. When it is burned out it can be replaced by any mechanic. The switches are on a little different plan. We have avoided the difficulty which has sometimes occurred of starting the car too suddenly, but which with careful management could always be prevented. We make it impossible to start suddenly by putting in a slow starting device, which starts the car gradually and effects a saving of power. It is not a rheostat. We are the only company that uses commutated field coils. We believe in them; we do not believe in the rheostat. You all know about our dynamos. The reason of their success is that they are a development and not an invention. Its efficiency is over 90 per cent. in the ordinary sizes, such as employed on street railroads; in some cases it is higher. One reason for its success is that its moving parts and centre of gravity is near the floor. The line construction of the company is acknowledged to be standard, in respect to simplicity, neatness and cost. We use the feeder system. That is a system of wiring in which the electricity is delivered at regular intervals of a few hundred feet into a trolley wire. This results in the fact that the electricity is delivered to a large mesh work of conductors in such a way that at every point in these conductors the pressure will be uniform."

MR. E. H. JOHNSON spoke with his customary eloquence of the Interior Conduit system as applied to underground work for carrying feeders for electric street railways and explained its many advantages.

MR. GEORGE W. MANSFIELD, of the Thomson-Houston company made some interesting remarks in regard to their system and its important features and merits.

1. See page 449.
2. See page 453.
3. See page 437.

In regard to new apparatus, we are constantly improving all our details. We are making the motor stronger wherever experience has dictated it to be necessary, and we are making it lighter wherever it is necessary. We are improving each detail of the entire apparatus, and increasing efficiencies; so that in a very short time we will have the most complete system. Our switches at each end of the car are under the hood of the car, so that in case of any accident or any trouble, the conductor at the rear end can cut the circuit, either with his switch or by pulling a trolley wheel down; and the driver also has that facility. We have a fuse box on our car, and it is a very simple matter to replace a fuse if the driver has been careless, or ignorant or unskilled, and turns his current on too quickly. That operates as a check against the man as well, as a record can be kept of the number of fuses used. We have a lightning arrester which we claim is the only one of practical value. As to our motors, we build 10, 15 and 20 h. p. of one type, and the same power of another type, so that we can use our motors either singly or double upon trucks of any gauge, from three feet three inches up to six feet. If the railroad men would get down to a uniform gauge, it would help us out very much. As to station apparatus, our dynamo has an efficiency of over 90 per cent. It will pull through more hard raps and do more service in a given space of time than any other. In our new work we are pushing ahead and building dynamos up to 2,400 and 2,500 h. p, and directly coupled to engines also. We are building heavy motors for excessive work and for tow work; and we are going into all sorts of devices and experiments in regard to constant speed motors and slow speed motors. We want to be sure first that any new thing is far superior to what we have, before we put it before the public.

MR. J. POTTER, of the Short Electric Railway Company, next addressed the meeting. He said: The Brush Company, as you know, has been in the business of building dynamo machines and electric batteries for many years, being the pioneers among the pioneers of that business, in the world. We have been building dynamos since 1876. We have recognized that the electric street railway work is the severest to which the dynamo machine has ever been subjected; and in starting out in our electric work, we aimed, as no doubt all others have aimed, to build a dynamo machine that would stand the rough work with as few failures by stoppage as possible; and in the next place to make the delays incident to such stoppage as brief as possible, and the repair work simple and inexpensive as possible. We claim that with our motor we have reached a high point of perfection in these respects. The difference in our motor is mainly in the type of armature, where we use a ring instead of the usual drum type of armature. There are many advantages which we obtain by the use of this type of armature. The bobbins or sections of the armature are all independent, and in case of any burn-out or trouble, it would be confined to a single bobbin. Again, we get a very great diameter of armature, as compared with others, and are enabled to use larger pinions and save greatly in wear. As a matter of fact, since the beginning of the present year, we have never burnt out a field magnet or armature coil in actual service. This will be confirmed by any road operating our system. The favor it has met with, and the large number of orders we are taking, speak loudest in praise of the system. Another feature is the insulation of the motor entirely from the frame-work of the car and from the ground. We think this is a great advantage. We believe that a great deal of the expense and trouble is due to the grounding of the motor, the bursting through and burning out of armatures, fields and commutators. This insulation is carried to the gears. We make them with an insulated web to deaden sound, and use steel pinions and steel gears, steel axle gears, and overcome the noise at the same time.

MR. W. J. CARRUTHERS-WAIN, president of the Tramways Institute of Great Britian and Ireland, was next called upon, and said: I came to this country with the hope of learning as much as I could about electric traction in America. What I want to know, and most people, is the item of depreciation and repairs; in other words, repairs and renewals, and the amount to be set aside as an annual sinking fund for the question of depreciation, which must inevitably ensue. It has struck me, not only in this assembly, but in many others, that figures, after all, are rather delusive. Electricity came under my observation this way. I was not satisfied, no man was satisfied, with the system of tramway traction in Europe up to within the last three or four years. We had leased a line from the Birmingham authorities, with the proviso that it should be operated by cable; but there was not enough business to make that system profitable. Electricity appeared to be the only feasible motive power; and in November, 1888, there was tried upon the Birmingham Central Tramways a self-contained electric motor, which was designed upon the Julien system by Mr. Thomas Parker, of the then Messrs. Elwell-Parker, Limited, and myself.

The directors of the Birmingham Central Tramways Company permitted the experiments to be conducted upon their lines upon condition that the electric motor to be used should be in the form of an engine, insisting that before they would consider the question of electricity at all in connection with their lines, they must be convinced by actual demonstration that the power was as great as, if not in excess of, their most powerful steam engines then in use; and when I point out that they are some 12 tons in weight, having cylinders nine inches in diameter, and carrying a pressure of 175 pounds to the square inch, you will agree it was no small task to attempt. However, upon actual trial the electric motor, although weighing only nine tons, when coupled to one of the steam engines, the electric engine hauled the steam engine in spite of the fact that steam was full on and pulling against the electric motor. We afterwards started and hauled with the electric car a load of some 30 tons up a grade of one in 32. We have also run with one charge of the accumulators 70 miles, hauling a car which, together with the load contained therein, weighed over six tons, and this on a very heavy grade of tramway traveling up a grade of one in 19, over 500 yards in length, during the day 10 times. This electric car has been so successfully run over their heaviest steam route, and given such satisfaction to the directors, that they gave an order for 12 electric cars, which have just completed what is undoubtedly the finest installation of its kind in the world.

The car is made to run upon a three foot six inch gauge, and is constructed to carry 50 passengers, 24 inside and 26 outside. It measures, over all, in length, 26 feet.

The foundation of the car is made of channel iron, strutted so as to give it great strength and rigidity. The car body is carried upon two bogeys of the ordinary kind, and the motor is geared to the axle of one bogey by a train of helical gearing. The accumulators are placed in trays, each tray containing eight cells, and these are carried under the seats of the car, the outer panels of which slide up behind the seats so as to admit of their being readily placed in position. The connections are so arranged that contact is made automatically as the trays are pushed in position. The whole forms four batteries. The switches are of the Julien type, and the car can be driven from either end. They are so constructed that the cells can be equalized and the batteries used either in parallel or series. The car, motor and batteries weigh nine tons, as against the steam engine and cars, 16½ tons, a large saving in dead load to be hauled. The work of charging the accumulators is reduced to a minimum by having a specially arranged balance lift or elevator. These work in pairs, one balancing the other. Each shelf is fitted with automatic connections, and is in every respect an exact duplicate of the car, so that when the accumulator trays are drawn thereon, automatic connection is made and the cells are charged whilst in position upon the rack without again being moved. We have 12 cars altogether, but are only running five. I may say, as a point of interest, that during the time that line was under construction, we worked it first by a system of horse tramways, and the average takings were about $750 a week. During the time the electric road was in process of construction, the receipts on the horse line were reduced to $600 a week. Immediately the electric cars were put on, the takings jumped to $1,250 a week. This was not due to any additional service, because it is precisely the same; not to any increase in population, because it has not grown so rapidly, but simply to the fact that we have been able to put on in place of the wearisome horse car a comfortable car moving by electric power. We have not renewed the plates at all. We expect to get a life out of our plates of six months. The question of profit on the workings of the storage battery is not a matter of speculation, but is a matter of dead certainty.

MR. E. L. WOOLLEY'S paper[1] was then read by Mr. Richardson.

MR. H. M. WATSON, the newly elected president, made a fitting speech after being introduced to the Association by Mr. Lowry, the retiring president.

A vote of thanks was tendered Mr. Lowry by the Association, as its retiring president.

The Convention then adjourned sine die.

WHAT IS SAID OF "THE ELECTRICAL ENGINEER."

THE ELECTRICAL ENGINEER of New York is now nearly nine years old. It started as a monthly, first increased in size as the electrical interests grew, and then became a weekly. It is now a magazine of between fifty and sixty (72) pages, and is one of the most reliable authorities on electricity in America.—*Boston Evening Transcript.*

NOVEL USES FOR ELECTRICITY.

The plant sold to Shailer & Schniglau, for the Lake View Tunnel, Water Works and Crib, by the Thomson-Houston Electric Co., Western Isolated Lighting Department, will be unique in some respects, as the dynamo will not only supply electric lights to the water works on shore, but will also be used to run the motor at the crib for ringing a fog bell, and the same dynamo will supply a number of lights to the light house on the crib, to take the place of the ordinary light house oil lamp.

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1. See page 453.

THE EXHIBITS AT THE BUFFALO CONVENTION.

Never, perhaps, was a larger display of exhibits made than that at the Buffalo Convention. It filled up the Arcade building, it crowded every corner of the Iroquois Hotel, and it overflowed into all the streets surrounding those places. By a somewhat amusing course of events, the supply men, in their praiseworthy determination to be early on the ground, practically pre-empted the Iroquois, so that when the modest consumers of their wares came along no room was left. The consequence was that a very large number of the "White Button" delegates had to seek quarters at the Tifft House, so that the "Red Button" supply men at the latter place found themselves favored by the interposition of Providence with a remarkable influx of the very men they came so far to see and from whose agreeable society it had seemed likely they might be cut off. It is needless to say that the most was made of such a glorious and unexpected opportunity.

ARCADE NOTES.

The American Leather Link Belt Co., of New York, represented by Mr. G. H. Fisher, showed samples of their patent joint link belting which they guarantee as superior to all others for driving generators.

Messrs. Chas. A. Schieren & Co., 45-47 Ferry street, exhibited in same space with Am. Link Belt Co., their perforated electric belting, and said in rhyme:

"Buffalo Electric Cars are sure to run,
But that black belt all full of holes is bound to take the bun."

Mr. E. P. Atkinson ably represented this house, which is making a very bold and successful push for electric railway trade.

The New York Car Wheel Works, of Buffalo, N. Y., made a handsome exhibit of their machined street car wheels. These wheels are specially strong and durable, and particularly adapted to electric traction.

The Buffalo Belting Works, Buffalo, were represented by Mr. J. W. Aldrich, who showed some fine samples of their leather belt and hose. One of their most novel and useful specialties was a steel pulley covered with leather, both pulley and leather being perforated instead of the belt, as in the present usual method. This type of belt was supplied to the Brush Electric Light Company, of Cincinnati, being 140 feet in length, 48 inches wide, and weighing 1180 lbs.

Pratt & Letchworth, of Buffalo, N. Y., showed their street railroad hames and trimmings for horse car work. They have a new corrugated steel fastening, specially useful for all kinds of wood working and car building. Mr. G. S. Crosby was on hand explaining their various devices and appliances. They also make all kinds of steel and malleable iron castings. This company manufacture the Gould automatic coupler, so well known in railway work.

The J. G. Brill Co., of Philadelphia, exhibited the vestibule of an electric motor car with patented doors. Mr. J. A. Hanna explained their patent folding and sliding vestibule doors and their new ratchet brake.

The New York Indurated Fibre Pipe Company made a good showing with indurated fibre pipe for electric conduits. This pipe is now being used by the Buffalo street railway for their underground feeder system. Mr. Gerald C. Collingwood represented the company.

The Blondell Manufacturing Co., represented by Mr. Blondell and Mr. E. Packer, showed their new Blondell car gear, by means of which the post is enclosed in a casing which takes the wear instead of the post, the box having liners which can be taken out and replaced when worn, obviating all wear on the box itself.

The Aluminum Brass and Bronze Company exhibited their new aluminum trolleys which present some remarkable features on account of their light weight and non-corrodable properties. Mr. Frank G. Stone, assisted by Mr. L. Schmidt, had charge of the exhibit, and explained the peculiar advantages of aluminum.

Mr. C. S. Van Nuis made a full exhibit of his admirable Ajax switches, which are in extensive use everywhere, and are now too well known to need much comment.

Hale & Kilburns Manufacturing Company, of Philadelphia, exhibited their new patent reversible high-back tilting car seat, specially for street car, suburban and elevated work. Mr. E. L. Hendrick, the contracting agent, represented the company.

The Volk Bottom Grip and Automatic Cable Crossing was shown by a handsome model.

The Collett Car Brake Co. exhibited their special car brakes which operate with a ratchet, and thereby brake quicker than the ordinary style.

The Eureka Tempered Copper Co., of North-East, Pa., had on exhibition a fine sample board showing specimens of commutator sections, armature bearings, trolleys, overhead trolley wire and all kinds of wire. Their tempered copper is stated to have a tensile strength three times as great as that of ordinary copper. Another peculiar fact is that the copper after being treated by this process shows greater purity than the purest obtainable ingot copper. Mr. A. L. Daniels looked after the interests of the company.

Chadbourne, Hazelton & Co., of Philadelphia, Pa., showed the Wenstrom dynamos and motors, for which they are the general agents. They had some very beautiful models of their electric street car trucks with motors attached, remarkable for their slow speed, and having but one gearing between armature and car axle. One of the special features of their machine is the embedding of the armature conductors in the iron core, thereby protecting them and reducing the magnetic resistance between pole pieces and armature to a minimum; and their system of winding is such as to greatly facilitate necessary repairs. One of the special points of their system is their admirable wood gearing, illustrated in a recent issue of The Electrical Engineer, which is giving the greatest satisfaction. Mr. Beals, the New York State agent, resident in Buffalo, represented the company.

Bickford & Francis, 53 and 55 Exchange St., Buffalo, were represented by Mr. Gardener, who showed some very handsome samples of leather belting. Their "B. C. D." belting has gained an immense reputation for its excellence and durability.

F. S. Pease, 65 and 67 Main St., Buffalo, had a large case of medals obtained in all parts of the world for his improved oils, which are in large demand and shipped everywhere. Mr. D. I. Bloodgood, the general agent, had charge of the exhibit.

Lemuel Wm. Serrell, of New York, exhibited a very beautiful model of the Milliken patent electric railway pole, which he handles exclusively, and of which he has sold 4,500 for the work in Buffalo.

The Stanwood M'fg. Co., of Chicago exhibited their new steel steps for street cars. These are manufactured specially insulated for electrical work. Mr. Stanwood was on hand showing and explaining the numerous advantages of his steps.

Pierce Bros., of Boston, manufacturers of special trolley wire fixtures and devices for street railway construction, had a well appointed exhibit of their products made at their factory at Leominster, Mass. Mr. H. L. Pierce, representing the firm, was kept busy explaining and taking orders for their specialties.

John A. Roebling's Sons Co. of New York, had a fine sample board of their bare, insulated and lead covered wires and cables on exhibition. They were represented ably by Messrs. Bailey and Perrine.

The Gibbon Duplex Railway Track Co., of New York, exhibited their duplex railway track, specially devised for electrical work, doing away with all necessity for rail bonds or joint connections, it being a perfectly metallic circuit throughout. Mr. Gibbon had all he could do explaining his ingenious system.

The Rowell Switch was exhibited by Mr. Rowell, of the Rowell American Switch Company. This ingenious device was illustrated in a recent issue of The Electrical Engineer, and was designed to fill the want for an automatic switch setter operated from the car direct. It certainly does its work in a most simple and efficient manner.

The Connecticut Motor Company, of Plantsville, Conn., showed two of their latest improved motors, one of ½ h. p., the other of 2 h. p. wound for 500 volts so as to run on street railway circuits. Mr. F. O. Rusling was in charge of the exhibit.

The North American Construction Company, represented by Mr. W. L. Adams, Buffalo manager, set up for inspection a large and beautifully gotten up switchboard, comprising volt and ammeters, regulator lamps, switches and meters. They also showed a new pattern U. S. generator and alternating arc lamp, all of which apparatus except the two last were in practical operation and a source of great and continual attraction.

The Aenchbacher Railway Truck Company, of New Orleans, La., showed a model of their truck for street car work.

The Gould & Watson Co., of Boston, had a stand covered with samples of their excellent molded mica goods, which have been so largely used in electric street railway work.

The Garland Car Heater was exhibited by the manufacturers, The Michigan Stove Company, of Detroit, Chicago and Buffalo. This heater is well known among electric railway men for its many merits, and is in wide spread use. Mr. F. P. McCanna had charge of the exhibit and explained to the uninitiated the advantages of their heaters.

The Okonite Company, of New York, made an extensive display of their wires and cables in charge of Mr. T. McCoubray, the special agent of the company, who had no difficulty in proving the wonderful strength and durability of his insulation, and was

kept hustling taking orders for wire to be used in street car work, a field in which it has always given the highest satisfaction.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., showed some very beautiful photographs of their bridge work. Mr. F. K. Field, the general agent, represented the company in his usual able manner, and was assisted by Mr. G. M. Harding. They handle iron work of all kinds, and build electric light and power stations entirely of iron. They have just taken a contract in Buffalo to build works for the Lake Erie Boiler Company.

MR. R. T. WHITE, of Boston, had a fine exhibit and was present showing a working model of his elevated road system which presents many new and striking improvements, and also his new cable system. His "Daisy" chairs were shown; they are solid iron, thereby widely differing from the ordinary steel frame chairs in general use.

THE JAS. SPEAR STOVE & HEATING COMPANY had a large number of their street car stoves on exhibition. Mr. A. J. Eickmeyer took care of the company's interests.

THE FULTON FOUNDRY COMPANY, of Cleveland and St. Louis, showed some fine electrical gears for street cars, of steel, rawhide and bronze. Messrs. White and Langdon represented the company.

EMMET BROS., 150 Broadway, New York, made a fine display of electric street car railway supplies, amongst which were many new and valuable devices. Mr. W. L. R. Emmet, represented the firm, who have a bright career before them.

ONE OF THE LARGEST and most prominent exhibits was that of the General Edison Electric Co. Their improved street car system was shown complete in every detail, comprising a Taylor elliptical spring truck equipped with two motors and double alternate toothed gearing. The motors have their armatures wound with the new Eickemeyer system of winding and are fitted with equalizing coils so that both take the same currrent. The switch board was a perfect work of art and contained all the necessary central station instrument and switches. The initial letters of the name of the company was on it in polished brass work formed of the regular switchboard appliances. The conduit tube system and two small Edison generators were shown. Mr. McGregor had charge of the exhibit. A new slate switch table was also exhibited, suitable for a power station and forming a most compact and complete arrangement. Near it was one of the new Lieb trolley, specially constructed, so that there is no strain on the car roof.

MISCELLANEOUS.

D. H. BATES, vice-president of the Accumulator Co., of New York, attended the convention and read a highly interesting paper on storage batteries. With him were W. W. Griscom, president, and E. A. Scott, of the Electro Dynamic Co., of Philadelphia. The electric car, equipped by the Electro Dynamo Co., and furnished with the Accumulator Co. batteries, was seen in practical operation at Cold Spring, and showed the rapid strides made in storage traction.

C. O. MAILLOUX and wife, of New York, were there, and thoroughly enjoyed their trip to Buffalo. Mr. Mailloux is engaged on highly important electric traction work in Washington.

J. ALEXANDER BROWN, representing *Poor's Manual of Railroads*, was in attendance at the convention, and distributed copies of their valuable book relating to street car lines, etc.

FRANK A. MAGEE, of the E. S. Greeley & Co., New York, was on hand hustling as usual for orders for this well-known house.

MESSRS. MUNROE & CAVELL, of *The Street Railway Gazette*, of Chicago, were on hand looking after the interests and comfort of all. They had handsome headquarters in the Iroquois and entertained their friends in royal style. They issued a very handsome souvenir, called "Some Familiar Faces," containing portraits of past and present street railway worthies.

C. T. CHAPIN, president of the Rochester Car Wheel Works, was in attendance.

MR. CLIFT WISE, the well-known engineer, was present. He is about to engage in electrical matters in New York, having now left Minneapolis.

J. W. FEIGEL, of the Feigel Car Co., was present at the convention, with Mr. Whittlesey. They are meeting with excellent success in the electric line.

THEO. LARBIG, of Holmes, Booth & Haydens, of New York, was on hand looking after the interest of his house and their wires.

C. B. HANNA, general agent of the car heating department of the Carpenter-Nevins Electric Heating Co., of Minneapolis, was in attendance. This company have reduced electric heating to a practical and economical basis, and have adapted it to a very large number of uses in general work.

W. J. COOK, vice-president of the McGuire Manufacturing Co., was at the convention. Their trucks are known from one end of the country to the other, and present some peculiar advantages for electric traction work. They were exhibiting two of their new trucks equipped with Westinghouse motors.

ELMER A. SPERRY, of the Sperry Electric Co., was present. The Sperry arc lamp and mining machinery are becoming more widely known and used all the time, and the new triple carbon arc lamp has produced quite a sensation. Mr. Sperry is devoting his attention to a number of new problems.

J. G. DORRANCE, who represents the Guarantee and Accident Lloyd's, and has his headquarters in New York, was present. Mr. Dorrance had some new features in insurance to offer street railway men.

THE WAINWRIGHT M'F'G. CO., of Boston, distributed a beautiful little set of celluloid tablets printed with their name and an engraving of their feed water heater, one of the sheets also containing a calendar for 1890-1891.

THE ALLEN PAPER CAR WHEEL CO., of Pullman, showed their new car wheels fitted to the McGuire truck. These wheels are in use under a number of electric cars.

THE INTERIOR CONDUIT AND INSULATION CO., of New York, made a most interesting display of their system for underground work, especially that for electric railway feeders, etc. It has already been adopted for Minneapolis and other places. A beautiful and large model was shown in the main hallway, first floor, where it attracted hundreds of visitors, and the company also had a number of small, highly finished miniature models, with case of polished wood, which street railway men could carry home. As is well known, the Interior system is now being extensively adopted also in car wiring, as well as for power houses, etc. The company were most ably represented by President E. H. Johnson and Mr. E. W. Little. It is also needless, perhaps, to add that Mr. Johnson's experience in electric railway traction caused much curiosity and inquiry as to his recent inventions in that line, as illustrated lately in THE ELECTRICAL ENGINEER.

A. D. WHITE, of Buffalo, shows a new ratchet track wrench specially designed for street railway construction, which comprises some unique points.

T. E. CROSSMAN, assistant to the secretary, Mr. Richardson, was present, conferring favors and information on every one as to the Association. We desire to thank him for many attentions and for much prompt and cordial assistance.

THE HERCULES CAR BRAKE & CAR STARTER, of Philadelphia, Pa., was handsomely exhibited.

THE HATHAWAY TRANSFER TABLE, of Cleveland, O., was shown by a full-sized table.

THE BALTIMORE CAR WHEEL CO., of Baltimore, Md., stated that their wheel exhibit is to be seen under every street car in Buffalo, and they showed a most emphatic testimonial letter from President Watson.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., of Pittsburgh, exhibited in practical operation on the Cold Spring division of the Buffalo Street Railway Co., a large vestibule car containing features of striking interest. The car is thirty-four feet long and is painted cream color and white, and the interior is most handsomely finished. The trimmings are gold, and French plate glass, beveled, is used throughout. A beautiful smoking-room, fitted up in embossed leather, occupies one end. The car is constructed with aisles on each side, and seats in the middle back to back, and will seat forty persons irrespective of the smoking-room. The car body was built by the Pullman Palace Co., and is mounted upon the Hubbard trucks, manufactured by the McGuire M'f'g. Co., of Chicago, which are fitted with the new Allen patent wheels made by the Allen Paper Car Wheel Co., of Chicago. On Wednesday afternoon hundreds of people rode on the car at Cold Spring.

THE EDISON GENERAL ELECTRIC CO. made a most stupendous exhibit, in size and completeness, in three sections. In parlor G-H, at the hotel, outside the door, was an exquisite sign of light made of a number of small incandescent lamps, which formed the name of the company in letters of fire. Inside was a large United States map showing the location of the roads using the Edison system. It was draped in bronze red and illuminated by incandescent lamps. On the opposite side of their parlor was a picture of Mr. Edison, and two maps, one of St. Paul the other of Minneapolis, where 200 cars and a power plant of several thousand horse power is being installed by the Edison Company. Between the two entrances was a banner naming the Edison district offices, etc. Two small model cars, complete with the Edison motor truck, were shown. There was also a large, framed blue print of the Schenectady works, and a large number of maps and blue prints containing engineering data of the system, a well appointed buffet, and many other minor objects of interest.

Mr. Edward E. Higgins, special agent of the railway department of the Edison Co., was in charge. One of the most unique features of the convention was prepared by Mr. Higgins, when each delegate received a little cylindrical tube, labeled as follows: "This cylinder contains a letter from the Edison General Electric Co. to Mr. —— —— of the American Street Railway Associa-

tion, which may be reproduced at the Edison headquarters, parlors G–H, Iroquois Hotel, Oct. 15, 16 and 17, 1890, by courtesy of the New York Phonograph Co." On opening the end of this package the delegate, whose curiosity is now thoroughly awakened, finds a little pasteboard cylinder covered with a film of wax, on a portion of which is a dark stripe. He is particularly requested not to rub his finger over this stripe, as in that case it will be difficult to reproduce the matter contained therein. By taking this to the Edison headquarters he heard a letter of welcome addressed to him, the contents of which were of a highly interesting nature. The company was represented by J. Muir, E. E. Higgins, J. H. Vail, C. D. Shain, C. T. Hughes, F. R. Chinnock, C. E. Hewitt, A. D. Page and others.

THE WORCESTER FIRE APPLIANCE COMPANY, of Worcester, Mass., exhibited their chemical fire pail. These pails are well adapted for use in electric light and power stations. Mr. G. O. J. Clark is the Buffalo agent of the company.

MR. JAMES GOLDMARK, representing Wallace & Sons, the well-known copper magnates and pioneer wire manufacturers, was present and distributed a neat circular gotten up specially for the occasion calling attention to their hard drawn wire for overhead railway construction and their numerous other valuable specialties. This concern was established as far back as 1848 and, therefore, may be said to antedate all the great modern electrical industries except the telegraph. It has, however, kept to the front in a most remarkable manner and to-day is doing a larger business than ever in the electrical field. It is not generally known, but it is none the less a fact, that the development of electric light and power dates back directly to the experiments made by this house and to the encouragement given by its members to what seemed then and to others hazardous and almost hopeless inventions.

THE ELECTRIC CONSTRUCTION AND REPAIR COMPANY, of Chicago, were represented by Mr. Wm. Sharpe. This company, which is one of the prominent and recent electrical organizations of Chicago, make a specialty of constructing electric street railways and manufacturing devices for the same, and also do all kinds of electrical repair work. Mr. C. M. Barclay, of Chicago, is one of the prominent men in the company.

MR. M. E. BAIRD, the well-known representative of the Eddy Motor Co., of Windsor, Conn., was on hand looking after the interests of his company. He reports business as rushing and the Eddy motors are gaining in popularity all the time, orders for sizes of 20 and 25 h. p. being very numerous just now. The recent large motor plant sold by Mr. Baird, in Toronto, is running in the most successful and satisfactory manner, and serves as an excellent precedent.

MR. W. H. GORDON, of the rising young firm of W. H. Gordon & Co., 115 Broadway, this city, was early on the ground and lost no opportunity of putting in a word for Simplex wire and the many other specialties he is handling that are of interest to electric railway men. If our casual observation be correct, he left for home a complacent and well satisfied man.

THE STREET RAILWAY JOURNAL of New York city was out in force, being represented by J. H. McGraw, C. B. Fairchild, F. D. Russell, E. E. Wood, E. H. Chapin and F. L. Kenfield, members of the home staff. A large parlor was occupied on the dining room floor, and two or more of these gentlemen were constantly in attendance there, as well as a skilled typewriter and stenographer. During the convention, the *Journal* issued daily a really magnificent bulletin of no fewer than 40 or 50 pages, regular size, and with its regular style of typography. The covers were beautifully printed in colors, each day different, and the whole made a superb evidence of intelligent, brilliant enterprise. The contents were beyond criticism, constituting not only a complete record of the daily proceedings, but of everybody in attendance and of all the exhibits. There were moreover a series of editorials, all written, of course, on the spur of the moment, yet dealing ably with the questions brought up in the convention. We have never before seen a convention bulletin half so well handled, and have nothing for our contemporary but profound admiration as well as congratulations upon its success.

THE NEW YORK INSULATED WIRE CO. were represented by Mr. J. W. Godfrey, who has already managed to push some big wedges into the electric railway work and follows up every opening closely. As the Hotel Iroquois is wired with Grimshaw, Mr. Godfrey posted up a few modest placards emphasizing the fact, and he did not forget to display a few others touching on the company's various specialties. Mr. Godfrey also distributed samples and copies of their admirable price list.

MR. C. J. FIELD, of the Field Engineering Co., was naturally on the ground, having so much work on hand for the Buffalo Street Railway Co. The company has carried out some of the largest electric railway contracts in the country, including the recent work at Newark. In this week's issue, we describe one of his recent plants, that at Salem-Winston, N. C.

THE ELECTRICAL ENGINEER, owing to the attention it pays to electric railway questions, was greatly in demand by the delegates, many of whom called in to secure two and three copies. Thanks to the courtesy of Chadbourne & Hazleton, the headquarters of the journal were established in the ladies' parlor, at the head of the main staircase and adjoining the dining room. The ENGINEER was represented by Messrs. T. C. Martin and M. C. Sullivan, of the New York office, and Mr. W. F. Collins, the Western manager, of Chicago.

MR. L. GUY FLITZ represented F. J. Kuhne, of 18 Front street, New York, the well known expert and specialist in lubricating and illuminating oils. Mr. Kuhne, as a manufacturer in these lines, has been devoting his attention lately to the lubrication of electrical machinery, and Mr. Flitz found many opportunities of giving electric railway men advice and information on the subject.

A VERY PLEASANT RECEPTION was given on Tuesday evening by Messrs. Cargill and McCarty, of the Thomson-Houston Co., to all the "supply" representatives,—electric railway, wire, poles, &c.,—then arrived. There was a large muster around a punch bowl of generous proportions filled to the brim with a most astounding punch. The evening from 9 to 12 was passed with speeches and stories, and wound up with an enthusiastic toast to the "T.-H." and all its efficient corps of engineers, experts and agents.

THE HOSPITALITY of the Buffalo street railway people was of the most profuse and royal kind. Every want was anticipated, and the programme of excursions, drives, &c., was endless. Each delegate and visitor was furnished with a pretty guide book, having a pocket crammed with street car tickets, and the white or red button admitted one everywhere. After the banquet on Thursday night came a special excursion to Niagara, by special train, and including a lunch at the Cataract House. It would have been impossible to do the thing better or with a happier spirit of hospitality, and we desire, if only for ourselves personally, to thank President Watson and his colleagues for attentions and kindnesses innumerable.

DR. AUSTIN, the versatile editor and proprietor of *Practical Electricity*, was one of the most active journalists on the spot, having just launched another enterprise, to which he has given the name of the *Electric Railway Advertiser*. The Doctor has our heartiest good wishes.

JOURNALISTIC INTERESTS were well looked after at the Convention. Besides the papers and representatives named elsewhere, the *Western Electrician* was represented by Messrs. Temple and Dickinson; *Electric Power* by Messrs. Blanchard and Ferguson; *The Electrical Review* by Mr. C. W. Price and associate; *The Electrical World* by Dr. Bell and Mr. Hart; *The Electric Age* by Mr. Taltavall and *Power-Steam* by Mr. Swetland.

DORNER & DUTTON, of Cleveland, O., showed one of their trucks adapted for electric traction work.

THE PECKHAM STREET CAR WHEEL AND AXLE COMPANY made a most attractive display of their trucks outside the hotel. Mr. Peckham was on hand expounding the principles of his cantilever and improved electric motor truck and fibrous steel motor axles. His fine exhibit deserved and received the closest attention.

THE GOLD CAR HEATING CO., of New York, exhibited their heat storage system. The heater is charged with steam and retains its heat from three to four hours. Mr. Charles Parker had the exhibit in charge.

THE SHORT ELECTRIC RAILWAY CO.—An exhibit which attracted an immense amount of attention was the vestibule car shown by the Short Electric Railway Company. It is elegantly furnished and most beautifully appointed, the chairs being of the most luxurious description. The car is fitted with bevel plate glass windows, incandescent lights, etc., and is altogether most perfect in its equipment both mechanical and electrical. It is mounted on a Brill truck.

THE WENSTROM MOTOR, &C.—In the hotel rotunda the Wenstrom motor was shown and also the noiseless gears. The exhibit was made by Chadbourne, Hazelton & Co.

THE STEAM GAUGE AND LANTERN CO., of Syracuse, N. Y., showed their new Electric Street Car Head-Light. Mr. Sawyer was in charge.

THE LEWIS AND FOWLER MFG. CO., of Brooklyn, N. Y., made a beautiful exhibit of their alarm passenger registers and general railroad supplies. They manufacture street railroad cars and equipment of all kinds for street railway work. This company distinguished itself by running a special train for its friends from New York to Buffalo.

THE ELECTRIC MERCHANDISE COMPANY, of Chicago, made one of the most elegant exhibits in Parlor F of their electric street railway supplies, to which line they pay exclusive attention. The genial manager, Mr. Mason, assisted by Mr. Gustin, laid himself out to entertain and explain their valuable specialties to the many visitors to their fine quarters. It is safe to say that every street railroad man visited the rooms for information or to place orders for trolleys, switches, insulators, motor parts, etc.

THE STANDARD UNDERGROUND CABLE CO., represented by Mr. G. L. Wiley, the New York manager, showed samples of their well known wires and cables. The cables now being laid by the

Field Engineering Co. for the Buffalo Street Railway Co. are those manufactured by the Standard Underground Co. and comprise mains and feeders amounting to 20 miles of No. 0000 wire.

THE RAE ELECTRIC RAILWAY SYSTEM was exhibited by the Detroit Electrical Works, and Mr. C. Benton and Mr. Paul Bossart were busy showing the salient features of their system. The most striking feature is the use of a single motor, gearing to both axles. This system has given signal success wherever it has been introduced. The truck is absolutely rigid and will run around the shortest curves without difficulty. These trucks are built by the Sheffield Velocipede Car Co., of Three Rivers, Mich. The Rae system was described fully in THE ELECTRICAL ENGINEER last week, and the paper was in great demand at the company's exhibit.

CHADBOURNE, HAZELTON & CO., of Philadelphia, the general selling agents of the Wenstrom Consolidated Dynamo and Motor, had one of the most popular and novel exhibits of their street railway system in the Ladies' parlor, Iroquois Hotel. Mr. Chadbourne, Mr. Hazelton, Mr. E. L. Tunis, president of the Wenstrom Co., Mr. J. B. Groom, Mr. Beals of Buffalo, and Mr. Foote of Cleveland, Mr. P. A. Dowd and Mr. H. P. Broughton, were all on hand explaining the advantages and peculiarities of their excellent electric traction system. They showed some very complete and beautifully made models of their apparatus and numerous handsome photographs.

THE J. G. BRILL CO., in parlor E, made quite a display of their trucks by handsome models. These included the trucks in use on the Short vestibule car; and they also exhibited a couple of the trucks outside the hotel.

THE WESTINGHOUSE ELECTRIC AND MFG. CO'S. RAILWAY DEPT., were located in parlor 68, and represented by Mr. H. McL. Harding, Mr. J. L. Barclay, Mr. Osgood Mr. Steward and Mr. Atkinson. They showed their magnificent car built by the Pullman Co., in practical operation on the Cold Spring line. They had a framed illustrated description of their system hung up, taken from the columns of THE ELECTRICAL ENGINEER, and attracting much attention.

THE THOMSON-HOUSTON CO. were out in force for business, located in elegant quarters on the second floor of the hotel, the the rooms being those used by Mr. Woolley, the proprietor. They were represented by Mr. Winthrop Coffin, Mr. Mansfield, Mr. Stebbins, Mr. Barr, Mr. Glaiser and Mr. Cargill, the other general agents of the company. Mr. Clark, Mr. McCarty, Mr. Morse and the technical men, Lieut. Cohoon, Mr. Stebbins and Mr. Wiggin, were all present. The company made no display of parts of motors, but exhibited their sweeper and snow plough on the Cold Spring division of the Buffalo Street Railway line, on Wednesday. These unique devices have never before been exhibited at any convention and attracted great attention from their evident practicability and adaptability to the uses for which they were designed.

THE LEWIS & FOWLER MFG. CO. showed a sample of their girder rail in Parlor 56, in addition to their handsome exhibit in the hotel rotunda.

DR. A. F. MASON, of Simplex fame, was on hand. He made no exhibit, for, as he puts it, everybody knows him and his wire, and, in fact, on more than one occasion, he has found himself addressed as "Mr. Simplex." He interested numerous people in his well known goods. The Simplex wire will be used for the Buffalo work.

THE SHORT ELECTRIC RAILWAY CO., of Cleveland, O., in addition to their exhibit of their vestibule car, made a splendid display in their magnificent reception room on the ground-floor of the hotel. They showed their motor, running on a table, and the various other ingenious devices belonging to their system, which was recently illustrated in THE ELECTRICAL ENGINEER. Prof. Short, Mr. Frenyear and Mr. Kinzelback represented the company. Treasurer Potter, of the Brush Co., and Mr. Curtiss directed matters and held quite a levee.

EUROPEAN CORRESPONDENCE.

LONDON.

Electric Traction in Glasgow.—Woodhouse & Rawson.—Servian Telegraphs.—Lectures on Meters.—National Telephone Company.—Edinburgh Exhibition.—The Brush Company's Works.—Electric Lighting in Newcastle.—St. Pancras.—Killarney.—Jarman System of Electric Cars.—The Tramway Accident in Italy.—Electric Lighting in Leeds.—Electric Traction in Chelsea.—Crompton & Co.—Telegraph Clerks.

A DEPUTATION of the Glasgow City Council has recently visited the electric line at Barking, worked by the General Electric Traction Company. It is said, so pleased were they with the demonstrations, that experiments will be made on the tramway lines in the northern city. I may mention that the tramways are so extensive in Glasgow that the cars run something like 4,000,000 miles per annum, and carry over 40,000,000 passengers.

An exhaustive report has been issued by Messrs. Woodhouse & Rawson, United Limited. £61,065 stands to the credit of the company, out of which the directors have proposed to pay a dividend of 15 per cent. on the ordinary shares, and 8 per cent on the preference shares. As was to be expected, considerable space is devoted to the launching out of the International Okonite Co. and the Elmore Companies. In spite, however, of owning several factories, no account is given of the profits made by manufacturing.

I hear that a Franco-Russian Company is about to organize a new telegraphic agency in Servia and the other Balkan countries, the Servian government having declined to renew its connection with the Vienna Correspondence Bureau.

Professor Silvanus Thomson began a course of lectures on Electric Meters at Finsbury College, on Monday night. The lecture theatre was crowded with students. The Professor opened with a dissertation upon the form and working of the present ampere meters, illustrating his remarks by use of the instruments. The subject of voltmeters will be dealt with next week.

Stafford, an important town in the Midlands, was last week connected to the trunk lines of the National Telephone Co., which gives communication with Birmingham, the black country towns, Manchester, Liverpool and London. The directors have decided to reduce the rentals of telephones from £15 to £10, and are considering the question of giving special conditions, to the trunk line subscribers. It is quite time that subscribers did derive a little consideration. The National Telephone Company has a peculiar manner of dealing with its patrons. A short time ago Mr. Muirhead, of Glasgow, brought at the invitation of the company several telephones of the Ader and Berthon type from Paris, which were placed in the London and Glasgow offices. A few months went by and Mr. Muirhead received a note from the company complaining that the telephones were infringements, and that they must be sent back to France. This request was not complied with, and the telephone company fetched away their instruments from Mr. Muirhead's place. The matter was brought before the courts, but owing to a lost contract the case was decided against the subscriber.

A meeting of the London committee of the Edinburgh Exhibition was held a few days ago. It was stated that, although the attendance had not been up to the expectation, it had exceeded three millions. It is extremely doubtful, however, whether this figure would have been reached were it not for the fact that the Forth Bridge is in the neighborhood. The determination of the Executive Council not to award prizes to electrical exhibitors has caused dissatisfaction.

The Falcon Works, Loughborough, acquired by the Brush Company about a year ago, have undergone considerable alteration. £20,000 have been spent in the erection and fitting up of spacious machine shops and foundry. Here will be manufactured the whole plant required for central stations. A few electrical cars have been built, and in the event of any great development of electric traction this company will no doubt receive many orders. For some time the two local electric light companies of Newcastle, which have had areas alloted to them, have been busy laying mains, and completing their plant in other ways. It has been wisely ordained that the streets should be divided in such a manner that no one company could create a monopoly, a little healthy competition has been the result, and the work has been pushed rapidly on. The public has not been slow to appreciate the efforts, and many are the private installations which have ceased to run since the companies started work. Large users of artificial lights, such manufacturers as have adopted electricity, and the postal authorities in that town are introducing it into every part of the central office. The experiment of lighting the streets by arc lamps has been successful, and more lamps will be erected.

Work in St. Pancras, which, by the way, is the only local body in London who will supply electricity, is pushed on. The contracts have been accepted by Babcock & Wilcox for boilers, Williams & Robinson for dynamos, Electric Construction Company for switchboards, and Clark, Muirhead & Co. for conductors.

After many discussion, the Town Commissioners of Killarney, Ireland, have decided to apply to the Board of Trade for a provisional order to supply light under the Electric Lighting Acts.

Last week the Electric Tramcar Syndicate, Limited, the owners of the Jarman patents, ran one of their new cars on a section of line placed at their disposal by the London Tramway Company. So well did everything work that it is expected that the cars will be adopted very soon. The car was of the ordinary type with accommodations for 44 passengers. A double motor is employed with the two armatures placed on one spindle. The gearing is a singe set of mortise wheels and pinions. The mortise wheels are of special construction with vulcanized fibre teeth. The driving arrangement is contained in a vertical case enclosing a cylindrical switch. By this switch all the necessary manipulations are made. The battery of E. P. S. accumulators supplying the current to the motors consists of 52 double E cells, 19 plates in each cell—the whole coupled in series. The capacity is 140 ampere hours. This system is likely to be introduced into Spain.

The full particulars of the tramway accident at Fiesole, in Italy, which mentioned in a previous letter, are to hand. I will not trouble you with the sickening details of the accident, but touch upon the reputed cause. The conductor, it appears, was drunk. He

started the car above the normal rate, and on the passengers becoming frightened, he appears to have lost his head and turned off the current by which he would have been able to reverse the car. Of course no sooner this was done than the gravity of the vehicle impelled it at a terrific rate down the hill. It jumped the rails and finally crashed into a parapet, the whole thing being smashed to atoms, killing several outright and severely maiming over twenty. So strong was public feeling in the matter that numbers patrolled the line preventing further cars running. It will be years, it is thought, before this electric line will pay a dividend, or even be worked without loss. It appears the driver was paid at the rate of 1s. 8d. per day.

It has been decided by the Leeds County Council that the lighting of the borough of Leeds shall be left to private enterprise, and it is probable that the Yorkshire House-to-House Co. will apply for an order. The Chelsea Electricity Supply Company has applied to the vestry of Chelsea district for permission to lay down rails for the use of electric tram cars.

Messrs. Crompton are completing central stations for the local companies in Northampton and Southampton.

In spite of the agitation among the telegraph clerks for some months past, their position does not seem to have materially improved. They complain that increments were made in their salaries and recalled after a few weeks operation. A meeting was to be held on Saturday, when 10,000 clerks were expected to be present.

H. S.

LONDON, Oct. 8th, 1890.

CORRESPONDENCE.

BOSTON.

The New England Electric Exchange.—Boston Electric Light Co.—West End Railway Work.—Walworth Light and Power Company.

THE New England Electric Exchange held its regular quarterly meeting this week, with Mr. Alex. P. Wright presiding. The reports, which were read and accepted, showed an increasing interest in the licenses granted to candidates. The members voted to make electric welding one of the branches of electric science, efficiency in which would assist in procuring a license, and it now ranks on an equal footing with electric light and power. A committee composed of Messrs. A. P. Wright, J. R. Lovejoy and C. R. Burleigh was appointed to confer with a committee from the New England Insurance Exchange relative to the change in the rulings of the new code of wiring, &c. Mr. H. C. Spaulding resigned his position as secretary and treasurer of the Exchange, and Mr. T. W. Sprague was appointed in his place.

At a meeting of the board of Aldermen this week the Boston Electric Light Company asked for permit to erect a 600-horse-power engine at 853-857 Albany street. A remonstrance having been made, the matter was referred to the committee on steam engines, with instructions to give a public hearing.

The West End Street Railway Company are equipping their electric cars with lanterns, the glass in which will be lettered with the name and number of the route on which they run.

BOSTON, MASS., Oct. 18, 1890.

PITTSBURGH.

Troubles at McKeesport.—A Peculiar Fire.—Electric Railway Work.

A TELEGRAM from McKeesport, Pa., reached me to-day reading as follows :—" A great fight is in progress between the local electric light company and the Edison people, and one which promises to reach the courts. The light company a short time ago contracted with the National Tube Works Company and the Monongahela Furnace Company to furnish a large number of arc lamps to be placed in the yards of the companies. The light company people made preparations for enlarging their plant and sent on to New York to the Edison Company to furnish the desired material, but instead the order was countermanded. Last Tuesday night a meeting of stockholders was held to elect new directors; among those present was President Herrick, of the Edison system, which owns about half the stock in the local company. He made a statement to the effect, that it was thought best not to enlarge the plant and that he should have a voice in the election of certain directors. The local faction objected to any such a move and a great rumpus occurred, which resulted in no election being held and the meeting adjourned. Mr. Herrick has ten days in which to settle the matter and if it is not accomplished at the end of that time the local stockholders threaten to withdraw and organize a new company." I give the telegram just as I received it and I know nothing more particularly about the facts.

A peculiar fire occurred here yesterday, which ended in the destruction of a telegraph pole, a cable box and did a great deal of damage to the electric wire system of the town generally. The telegraph pole stood opposite the Union Depot in this city and at its top it contained a box with several hundred Western Union telegraph wires. It is supposed that one of these wires became crossed with an electric light wire and thus started a fire in the cable box. Immediately a flame emerged from the box and soon the pole was surrounded with a blaze giving the idea of a gigantic torch. An alarm was sent in to the fire department and in a few minutes the engines arrived on the spot. By this time the pole was sending flames ten feet in the air, but one stream of water soon extinguished the fire.

The Pleasant Valley Electric Railway Company in this city has issued a circular to the patrons of its line to the effect, that in the future no car will be allowed to carry more than 45 passengers at a time.

The authorities of the city of Allegheny have decided to increase the capacity of their electric light plant by adding 100 arc lamps. The Westinghouse Electric and Manufacturing Company has the contract for the electric apparatus.

PITTSBURGH, Oct. 17, 1890.

SOCIETY AND CLUB NOTES.

THE BROOKLYN INSTITUTE.

On Friday, Oct. 26, Dr. S. S. Wheeler, will deliver a lecture before the Department of Electricity, on "Certain Applications of Electricity." The lecture will be illustrated by experiments and the meeting will be held in the Lecture Room of the Brooklyn Y. M. C. A. Building, 502 Fulton St.

At the regular weekly meeting October 10, of the Electrical Department of the Brooklyn Institute, the following officers were elected for 1890-91 : James Hamblet, Supt. of the time service of the Western Union Telegraph system, president ; Prof. Samuel Sheldon, first vice-president ; J. P. Wintringham, second vice-president ; William H. Randall, secretary and R. W. Bayles, treasurer.

THE TELEGRAPHERS' BALL—PRESENTATION TO MISS STEPHENSON.

The second grand annual reception of the New York Telegraph Club was held at the Central Opera House, this city, on October 15. There was a large and brilliant gathering, and special interest was given to the occasion by the presentation to Miss Kittie B. Stephenson, the winner of the first prize, Ladies' Class, in the late Fast Sending Tournament, of a handsome silver cairngorm brooch, the gift of the Hon. James D. Reid, U. S. Consul to Dunfermline. After a few introductory remarks by President E. E. Brannin, of the Club, Mr. W. J. Dealy, the well-known manager of the Western Union operating department at "195," made the presentation. He read a letter from Mr. T. C. Martin, to whom Mr. Reid had forwarded the brooch, and the following cablegram :

"DUNFERMLINE, October 15.

"T. C. Martin, New York. With presentation of brooch, if deemed worthy of so formal a ceremony, please present my love and grateful memory to all present. My heart is in New York.

"J. D. REID."

Here the entire assemblage shouted in a mighty chorus, as a salute to Mr. Reid, the telegraphers' fraternal signal of good will, "73." This Mr. Dealy responded to with one of his eloquent and epigrammatic speeches. The acknowledgment, on behalf of Miss Stephenson, was made by Mr. E. C. Cockey, who said of the donor : "His memory will always be wreathed with the grateful and loving thoughts of every member of the craft. A thousand things he has done, ten thousand words he has uttered will spontaneously come back to us, and will make us feel how much better and richer we were because we knew him, and honored him and loved him. It is therefore not only with present pride but with loving care for the future that Miss Stephenson asks me to say that she shall guard the pin as her most precious possession." As Mr. Cockey finished his felicitous remarks a letter to Miss Stephenson was handed in from Mrs. M. E. Randolph, in which she said that the significance of this occasion seemed to call for a woman's voice, and spoke of Mr. Reid's work in opening to women the doors of telegraphy as a new and honorable profession

The brooch is a beautiful piece of work, being a deer's head, in the antlers of which is placed the stone. It is deservedly admired by all who have seen it. Miss Stephenson will ever prize it, remembering, too, Mr. Dealy's happy phrase, "This pin, set with Scotia's choicest stone—the cairngorm, brilliant gem—to crown your victory ; and happy design—the deer—emblem of the speed that won it."

REPORTS OF COMPANIES.

STOCKS AND BONDS.

SPRAGUE, WASH., is to be bonded for $35,000 for electric lights and water works.

THE SCHUYLER ELECTRIC CO.

At the annual meeting of the Schuyler Electric Company held at the office of the company in Middletown, on Thursday, October 9, 1890, the following gentlemen were chosen directors: S. H. Butler, John N. Camp, Walter B. Hubbard and C. E. Jackson, of Middletown, Conn., C. N. Wayland and C. L. Buckingham, of New York, and Chas. E. Dustin, of Hartford. A meeting of the board of directors was held immediately after, and officers for the ensuing year were elected, as follows: President, Chas. E. Dustin; vice-president, S. H. Butler; treasurer, Jos. T. Elliott; secretary, D. J. Glazier.

INVENTORS' RECORD.

Patents issued Oct. 14.

Alarms and Signals:—*Electric Signaling Apparatus*, T. A. Edison, 438,304. *Police-Patrol Signal-Box*, C. Plumb, 438,361. *Annunciator*, A. F. Stanley, 438,390.

Conductors, Conduits and Insulators:—*Method of Insulating Electrical Conductors*, T. A. Edison, 438,309. *Connector for Electrical Conductors*, G. J. Brennen, 438,400. *Insulating-Joint*, S. H. Short, 438,495. *Electric-Wire Distribution Box*, W. H. Eckert and W. H. Gregory, 438,592.

Distribution:—*System of Electrical Distribution*, T. A. Edison, 438,308.

Dynamos and Motors:—*Electric Motor*, E. Thomson, 438,204. *Commutator for Dynamo-Electric Machines*, T. A. Edison, 438,302. *Magneto-Generator*, N. B. Ginochio, 438,431.

Galvanic and Thermo-Electric Batteries:—*Composition of Matter for Making Cells or Retaining Vessels*, O. A. Enholm, 438,311. *Acid-Proof Retaining Vessel*, O. A. Enholm, 438,312. *Insulating Appliance for Electric Batteries*, S. C. C. Currie, 438,582. *Galvanic Battery*, R. E. Murphy, 438,586.

Lamps and Appurtenances:—*Electric-Arc Lamp*, A. Apps, 438,134. *Manufacture of Incandescent Electric Lamps*, T. A. Edison, 438,298. *Manufacture of Carbon Filaments*, T. A. Edison, 438,299. *Gauge for Testing Fibers for Incandescent-Lamp Carbons*, T. A. Edison, 438,300. *System of Electric Lighting*, T. A. Edison, 438,301. *Arc Lamp*, T. A. Edison, 438,303. *Manufacture of Incandescent Electric Lamps*, T. A. Edison, 438,307. *Lamp-Base*, T. A. Edison, 438,310. *Electric-Light Shield*, A. A. McCreary, 438,419. *Incandescent-Electric-Lamp Socket*, J. W. Collier, 438,431.

Measurement:—*Apparatus for Measuring the Strength of Electric Currents*, S. C. C. Currie, 438,226.

Metallurgical:—*Method and Apparatus for Magnetic Separation of Ores*, J. M. McMahon, 438,357.

Metal-Working:—*Method of Utilizing Electricity in the Formation of Sheet-Metal Articles*, M. W. Dewey, 438,406. *Apparatus for Forming or Shaping Sheet-Metal Articles Electrically*, M. W. Dewey, 438,407 and 438,408. *Method of Utilizing Electricity in the Formation of Metallic Cartridge Cases*, M. W. Dewey, 438,409. *Method of and Apparatus for Working Metals by Electricity*, G. D. Burton, 438,525.

Miscellaneous:—*Circuit-Closer*, T. Marcher, 438,167. *Coin-Actuated Box*, J. W. Patterson, 438,174. *Circuit-Closer*, J. Geary, 438,231. *Electric-Safe Lock*, W. H. Hollar, 438,236. *Electric Switch*, C. W. Smith and C. J. Lyons, 438,260. *Fuse-Block*, T. A. Edison, 438,305. *Automatic Cut-Out*, G. W. Richardson, 438,326. *Circuit-Interrupter*, N. Chaize and J. Chaize, 438,344. *Thermal Cut-Out*, W. R. White, 438,394. *Electric Means for Preventing Boiler Incrustations*, A. B. Faunce, 438,579. *Automatic Safety Cut-Out for Electric Circuits*, G. T. Woods, 438,590.

Railways and Appliances:—*Electric-Motor Car*, J. F. Shawhan, 438,192. *Gearing for Motor-Cars*, O. C. Smith, 438,127. *Support or Hanger for Trolley Wires*, H. C. Wirt, 438,211. *Trolley-Pole*, J. M. Andersen, 438,219. *Electric Railway Conduit System*, M. Wheless, 438,262. *Electric Railway System*, F. J. Sprague, 438,293. *Trolley-Wheel for Electrically-Propelled Vehicles*, L. Pfingst, 438,359. *Contact for Overhead Electric Railways*, A. H. Chadbourne, 438,404. *Electric Railway Brake*, C. J. Van Depoele, 438, 452. *Electric Railway*, H. E. Swift, 438,561.

Secondary Batteries:—*Regulation and Control of Storage Batteries*, S. C. C. Currie, 438,145.

Telegraphs:—*Telegraph Instrument*, J. Geary, 438,233. *Telegraph-Key*, C. H. Crockett and L. O. Dedrick, 438,530.

Telephones and Apparatus:—*Telephone*, T. A. Edison and E. T. Gilliland, 438,306.

FRANKLAND'S RESEARCHES ON THE CHEMISTRY OF STORAGE BATTERIES.[1]

THE chemical changes which take place during the charging and discharging of storage batteries have been the subject of considerable difference of opinion amongst chemists and physicists. Some authorities have maintained that the effects are dependent on the occlusion of oxygen and hydrogen gases on the plates, whilst others, regarding the question from another point of view, have held that lead sulphate plays an important part in the phenomena. That the differences of opinion amongst experts have been widely divergent may be recognized from the fact that scientists, who, apparently, are well competent to express their views, have asserted that no chemical change of the lead sulphate occurs either in the charging or discharging of the plates.

In order to test the accuracy of the former opinion, Dr. Frankland, some time ago, undertook a series of experiments, the results of which were communicated to the Royal Society (*vide* Proceedings Royal Society, XXXV., p. 67). Two plates of lead were twisted into a corkscrew form, the gutter of the screw being filled with red lead; these plates were immersed in dilute sulphuric acid and charged in the usual way. When these plates were subsequently heated and the gas evolved, collected and examined, it was found that mere traces of oxygen and hydrogen were expelled, whereas, if the theory had been correct, there should have been a copious evolution. Hence, it was concluded, that the important agent in the cell is not constituted by the occluded gases.

With regard to the lead sulphate, Dr. Frankland observed that in charging a storage cell, a considerable amount of sulphuric acid disappears, and is accompanied by a certain deposition of lead sulphate, but that the deposit formed is inadequate to account for the total acid which has disappeared.

The strength of the acid ceases to diminish and afterwards increases as the charging of the cell proceeds; this change continues until the maximum charge has been reached, and oxygen and hydrogen gasses are evolved from the positive and negative plates respectively.

When the cell is discharged, the phenomena above described are reversed, the specific gravity of the acid decreasing from the point from which it began to increase on the charging of the cell.

From these experiments and the observations made upon them, Dr. Frankland deduced the following results, representing the changes which occur in *charging* a storage battery, viz.:

1. The electrolysis of hexabasic sulphuric acid (*i.e.*, $H_6\,SO_6$) according to the equation

$$H_6\,SO_6 = \underbrace{SO_3 + 3O}_{\text{on + plate}} + \underbrace{3\,H_2}_{\text{on − plate}}$$

2. The reconversion of the evolved sulphuric anhydride (SO_3) into the corresponding acid ($H_2\,SO_4$).

3. Chemical action on the coating of the positive plate according to the equation

$$PbSO_4 + O + 3\,H_2O = PbO_2 + H_6\,SO_6.$$

4. Chemical action on the coating of the negative plate according to the equation

$$PbSO_4 + H_2 + 2\,H_2O = Pb + H_6SO_6.$$

When the storage battery is *discharged*, the first two changes observed in charging the battery are repeated. Further, on the coating of the positive, formerly the negative electrode, the chemical change which takes place is represented by the equation

$$PbO_2 + H_2 = PbO + H_2\,O$$

on the coating of the negative. Finally, the positive electrode, the change occurring is represented by the equation

$$Pb + O + H_6\,SO_6 = Pb\,SO_4 + 3\,H_2\,O.$$

Hence Dr. Frankland formed the opinion that the formation of the cell consists in the more or less thorough decomposition of those portions of the lead sulphate comparatively removed from the conducting metallic nucleus of the lead. Lead sulphate possesses a low specific conducting power, whilst lead peroxide, and especially spongy lead, offer comparatively little resistance to the current, which is thus enabled to bring the outlying portions of the coating under its influence.

Since these results were published Dr. Frankland has been pursuing his researches in the same direction. He undertook a series of experiments with a view to ascertaining what lead compounds actually take part in the chemical reaction in charging and then discharging secondary batteries.

A quantity of lead oxide (PbO_2) reduced to a fine powder was treated successively with portions of dilute sulphuric acid until the liquid became permanently acid. On being allowed to stand, a buff-colored precipitate separated from the mixture and was found by analysis to possess the formula $Pb_5\,S_3\,O_{14}$.

1. London *Electrical Review*.

When finely powdered red lead (Pb_3O_4) was treated in the same way with dilute sulphuric acid, the powder which settled on standing was brownish-red in color, and was found on analysis to have the constitution $Pb_3\,S_2\,O_{10}$.

Dr. Frankland considers that these hitherto unknown or undescribed salts constitute the original active material of storage cells, and that the following equations accurately represent the reactions which take place on the surface of the plates on charging and discharging the battery.

A. If the buff-colored salt is the active material used, then

I. on charging—

(1) Positive plate, $Pb_5\,S_2\,O_{14} + 3\,H_2\,O + 5\,O = 5\,PbO_2 + 3H_2\,SO_4$.

(2) Negative plate, $Pb_5\,S_2\,O_4 + 5\,H_2\,O = 5\,Pb + 3\,H_2SO_4 + 2\,H_2\,O$.

II. on discharging—

(1) Positive plate, $5\,PbO_2 + 3\,H_2\,SO_4 + 5\,H_2 = Pb_5\,S_2\,O_{14} + 8\,H_2\,O$.

(2) Negative plate, $5\,Pb + 3\,H_2\,SO_4 + 5\,O = Pb_5\,S_2\,O_{14} + 8\,H_2\,O$.

B. If the brownish-red colored salt is the active material used, then

I. on charging—

(1) Positive plate, $2\,Pb_3\,S_2\,O_{10} + 2\,O_2 + 4\,H_2\,O = 6\,PbO_2 + 4\,H_2\,SO_4$.

(2) Negative plate, $Pb_3\,S_2\,O_{10} + 4\,H_2 = 3\,Pb + 2\,H_2\,SO_4 + 2\,H_2\,O$.

II. on discharging—

(1) Positive plate, $6\,PbO_2 + 4\,H_2\,SO_4 + 4\,H_2 = 2\,Pb_3\,S_2\,O_{10} + 8\,H_2\,O$.

(2) Negative plate, $3\,Pb + 2\,H_2\,SO_4 + 2\,O_2 = Pb_3\,S_2\,O_{10} + 2\,H_2\,O$.

It is worthy of remark that in practice only half as much material seems to be necessary for the negative as for the positive plates, and this is evidence in favor of the latter alternative, B, being correct.

We cannot assume, however, that there is nothing more to be discovered concerning the chemical action of storage batteries. The subject is full of complications, and it is to be hoped that electricians will receive further and large assistance from chemists who alone, perhaps, are able to throw the necessary light upon these obscure matters.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT

MAKING ALUMINUM IN PITTSBURGH.

THERE is probably no other metal the usefulness of which is so extensive as aluminum and yet its practical utility has only been very recently successfully demonstrated. Of course, the metal was known long ago, and its advantages were at once realized, but the great cost of its production prevented it always from becoming a competitor of other metals.

That this obstacle has now been overcome and that aluminum bids fair to eclipse even iron and steel in many instances, as a commercial commodity, is mainly due to electricity. Owing to the fact that electricity has the faculty of separating pure aluminum from its surrounding impurities and that it helps to reduce the expense of production, the metal has now become useful in many ways.

There are, however, still but very few aluminum factories in the world and among them the Pittsburgh Reduction Company is one of the largest.

Since the electric current plays a very important part in the manufacture of the metal, a visit was paid to the works a few days ago, in order to get an idea as to the manner in which electricity is applied in the process of producing aluminium.

Aluminum exists in nature in the form of an oxide so refractory in its character as to make reduction in any ordinary furnace impossible, the only means which have been found available for its reduction on a commercial scale being by electrolysis. It is this method which has been perfected by the Pittsburg Reduction Company.

The company's power plant consists of several Babcock and Wilcox boilers and the engines are three in number, two being of 200 h. p. of the Westinghouse compound type and one a Westinghouse automatic engine of 125 h. p.

The electric plant consists of four direct current dynamos made by the Westinghouse Electric and M'f'g Co. and the U. S. Electric Lighting Co., of Newark, N. J. The armatures of these dynamos are shunt wound and all of them furnish the current for the reducing pots. Two of these dynamos are immense machines, they are wound to generate a current of 2,500 amperes at a pressure of fifty volts, running at a speed of 325 r. p. m. These two dynamos are probably the largest in the country, and they have been especially made to do the work in this factory. The other two machines furnish a current of 1,000 amperes each, at a pressure of 25 volts, running at 1,000 r. p. m.

The two larger dynamos are connected in parallel, as well as the two smaller ones, though on an independent and separate circuit. The arrangements for transmitting the 5,000 ampere current from the two large dynamos are striking and somewhat novel in the way of electric current conductors, two copper bars, each six inches by one-half inch, having a total area of cross section of six square inches, being used. For the 2,000 ampere current from the small dynamos, a similarly shaped bar, four inches by one-half inch, is used. Fortunately, it is necessary to carry the current but a very short distance on such expensive conductors as these.

Since the works of the Pittsburgh Reduction Company have been operated, their production of this valuable metal has been constantly on the increase and the demand is now so great that the company is contemplating an enlargement of its plant in order to make the producing capacity greater than it is at present. The Pittsburgh company also operates a similar plant in Manchester, England.

J. ELLIOTT SHAW & CO.

The above well-known Philadelphia house announce that on November 1, they will remove to their new store and factory, 623 Arch street, that city, where they will have far better facilities to meet the demands made upon them for reliable goods. They are, in fact, driven to make this change by the growing demand for such specialties as their Norway iron frame bells, &c.

THE NATIONAL ELECTRIC SYSTEM.

The National Electric Manufacturing Co., of Eau Claire, Wis., is crowded with orders for its lighting apparatus, and finds it well nigh impossible to keep within hailing distance of its new contracts for plant. This is, of course, a pleasing state of affairs, and the company hope to catch up soon by an increase of its facilities.

NEW ENGLAND TRADE NOTES.

ROLAND T. OAKES & COMPANY are installing a 120 ampere Perret dynamo, in the factory of Messrs. B. B. Webber & Co., of Holyoke, Mass., which will furnish current for 110 16 c. p. incandescent lights, and 12 Ward arc lamps of 1800 candle power.

THE GOULD & WATSON CO., of Boston, the well-known manufacturers of moulded mica insulators, and dealers in mica, have published a very attractive and complete catalogue of their specialties for electric railways and other work. The book embraces, trolley line insulators, pull over or curve brackets, strain insulators, line insulators, pole insulators, insulated line hooks, and many other insulating devices. The Gould & Watson Co. have done a very successful business in these goods, having over 65,000 of their trolley line insulators in use, and they are constantly making new applications of their material for various insulating purposes. The catalogues will well repay a careful perusal.

THE ROBINSON RADIAL CAR TRUCK CO., of Boston, have printed and are issuing a special circular giving comparison of weight, seating capacity, power required, and cost to propel and earning capacity, between their car and any form of eight-wheeled car. The circular claims a net total gain in favor of the Radial car of 36¾ per cent. and should be carefully studied by every electric railroad engineer.

THE EASTERN ELECTRIC SUPPLY CO., of Boston, have recentla sold quite a large amount of goods to a Paris house, including y large number of Burnley dry batteries. Mr. Henry F. Kellogg, a gentleman well and favorably known among the electrical fraternity, has connected himself with this company, and is at present traveling in New England in their interests. The following officers of the company have been elected :—Mr. Maybin W. Brown, president; Albert Otis Smith, treasurer; Messrs. C. F. Hutchinson, of Everett, Mass., L. A. Dean, Boston, Samuel R. Moseley, Hyde Park, and the two first mentioned gentlemen as directors. Mr. James E. Cook has been appointed attorney for the company.

RUSSELL ELECTRIC LAMP CO.—Mr. E. C. Russell, the inventor of the Russell lamp, and Mr. Abram Hoffecker, have sold their Canadian rights to the Craig Russell Electric Company, of Montreal, which lights five Canadian cities, for the sum of $60,000.

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AN ELECTRIC TIME AND DATE STAMP.

AT the present day, when the exigences of business require an accurate record of the time and date at which transactions are effected, it is quite obvious to everyone that a convenient piece of mechanism which will automatically and continuously record the time of day, as well as the day of the month and year, must evidently be of great convenience

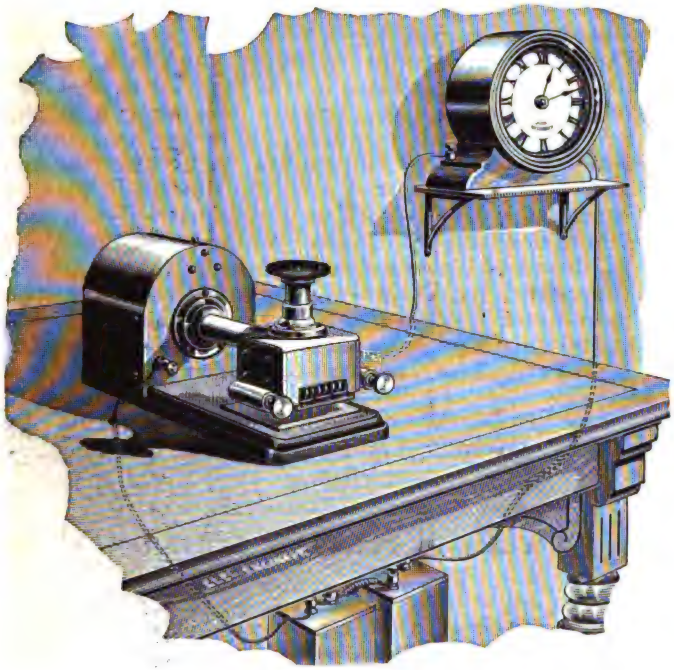

FIG. 1.—A NEW ELECTRIC TIME STAMP.

and value. Among the numerous cases in which such a record is not only highly desirable, but frequently indispensable, we may mention the transactions on the stock exchange, the recording of fire and police signals, the delivery and reception of telegraph and cable messages, the recording of all legal documents, and of many amusements such as billiards, boating, etc., the cost of which is based upon time; and in general business life a convenient time record is evidently a desirable addition to the office equipment.

To afford the means of obtaining such a record the New York Electrical Device Co., of this city, have just brought out a number of time and date stamps in which, by the use of electricity, some of the defects of the purely mechanical stamps heretofore in vogue have been removed. This has been accomplished by making the clock which gives the time, entirely independent of the stamping mechanism, and thus avoiding the shocks and jars to which it would otherwise be subjected.

The accompanying engraving, Fig. 1, shows the swinging arm model of the recorder, one of which has lately been put in successful operation on the New York Stock Exchange, to record the departure and arrival of messengers. The apparatus consists simply of a stamp, the variable characters of which are mounted as type wheels at the end of a swinging arm. These wheels are connected in a simple manner with the armature of an electro-magnet placed at the other end of the arm and actuated by electric impulses controlled by the clock shown. The latter is arranged to close the circuit for a fraction of a second at the beginning of each minute, the result being that the type wheels are correspondingly revolved to accord with the indications of the clock. Two cells of an open circuit battery is all that is required as the electric energy.

Another model of this apparatus has been designed, in which the type wheels are revolved and the recording, as well, is effected electrically. This instrument, which is illustrated in the engraving, Fig. 2, is made with a wide-lipped slot so as to allow of the insertion of a large sheet, and is connected to the clock in the same manner as the instrument just described. When it is desired to stamp the time it is only necessary to press the button at the front of the case. This energizes the electro-magnet, the movable armature of which gives the desired impression.

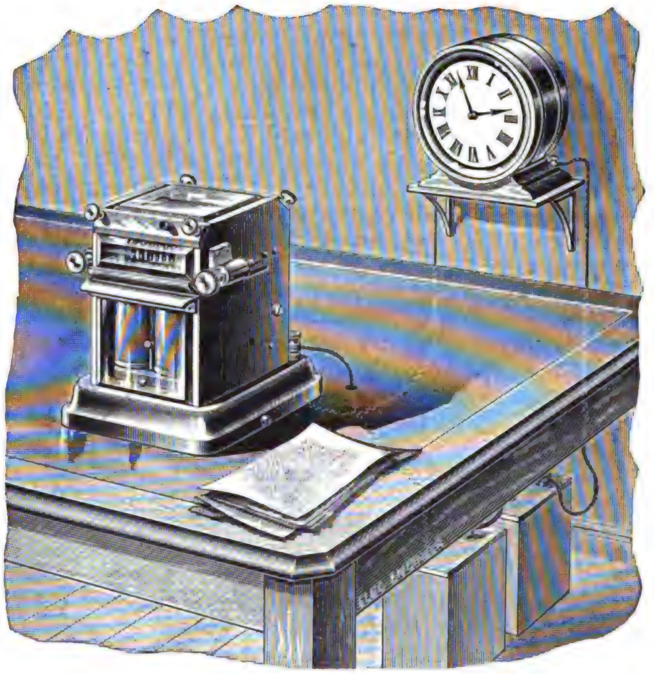

FIG. 2.—A NEW ELECTRIC TIME STAMP.

The apparatus is so constructed that it prints face up on top of the paper. As the clock is entirely independent it is evident that any number of stamps can receive their time impulses from a single central clock, which is very desirable in many cases, as, for instance, in the issuance and reception of railroad orders, where an entire section of a road could be controlled by a single time wire.

A modification of the model just described has been specially adapted for stamping time upon a continuous paper

tape such as is employed in the reception of cable or automatic telegraph messages and fire and police signals. One of these has been placed in the office of one of the Atlantic cable companies, where its accurate work has elicited much commendation.

OVERHEAD AND TRACK WIRING FOR ELECTRIC RAILWAYS.

BY W. H. CULL, SUPT. ALBANY CITY RAILWAY.

It has been said that constant vigilance and absolute cleanliness are the two requisite elements to the successful operation of electrical apparatus. It is certainly true when applied to an electric railway. Too much attention cannot be given to the overhead construction and track wiring. Iron poles are probably the most desirable for many reasons, and should be set at intervals of 125 feet, six feet deep, in a rich bed of concrete, surrounding the pole from 12 to 15 inches, and should be of sufficient strength to show a deflection of not more than four and one-half inches at the top of the pole when put under a direct strain of 800 pounds, and to stand a strain of 2000 pounds without bending them beyond their elastic limit. The top should be provided with a device admitting of the most perfect insulation for the suspension wires, and if guard wires are to be put up, with an extension for the guard suspension wires, at least 10 inches above the trolley suspension wire. The trolley wire should not be smaller than No. 0, hard drawn copper wire, supported by suspension wires of galvanized steel wire of a size not smaller than No. 5 American gauge; the hangers, or ear bodies, should be of sufficient strength to stand any sudden strain without breaking and still be as light as possible. The hangers should be provided with an insulation capable of eliminating moisture. From recent tests made we have found that mica or glass gives the best satisfaction. It is well to imagine that no insulation is good enough when insulation is desired. Utmost care should be taken in wiring curves; instead of building a trolley wire directly over the centre of the track it should be placed directly over a point to be determined by the radius of the curve between the centre of the track and the out-side rail and should be as high as the tension on the trolley pole will permit. If a speed exceeding three miles an hour is prohibited on curves constructed in this manner, the trolley wheel will rarely, if ever, run off. Trolley wires put up in sections are absolutely indispensable to the good working of an electric railway. The trolley wires should be divided in sections of sufficient numbers to permit of trouble on the line being located easily and rapidly and also to enable a large portion of the road to be operated while the disabled portion is being repaired. The frequency of these divisions must depend largely on the peculiarities and situation of the different roads.

On roads where it is practicable, an independent and separate feeder wire connected to each section of trolley wire and provided with a circuit switch at the power station would give a road a most complete system of sectional trolley wiring. In the event of trouble being noticed, it would enable the attendant at the power house to ascertain what section the trouble was on in two or three minutes, and also, to keep the uninterrupted portion of the road in operation.

The entire line should be constantly patrolled by linemen trimming trees, examining insulators, and especially curve wiring. All insulators should be treated to a coat of some insulating paint as often as once in three weeks.

Track wiring and ground connections are the most important factors in the operation of an electric road. The supplementary or return wire ought not to be smaller than No. 0 wire connected to each rail twice by a wire not smaller than No. 6. All joints should be well soldered and wiped as plumbers joint a lead pipe. In selecting a device to connect the bond wires with the rail, care should be taken to get the one having the least number of connections and making the most perfect contact. The fewer the electrical connections and the better the electrical contact the more perfect will be the electrical efficiency of the plant.

In Albany we have a most extensive system of track wiring and track ground connections, with which, together with metallic stringers under some of our rails, we have succeeded in getting a return circuit of so low a resistance that our current does not leak to telephone circuits, and consequently does not interfere with telephone service. We have placed copper ground plates, having a surface of about 36 square feet, at intervals of 1000 feet and of sufficient depth to insure their being in permanent moisture.

The Albany Railway, with a few exceptions, have carried out the suggestions set forth in this paper, and as a result they are enabled to take their cars up the heavy grades of their three lines, developing an average of only nine indicated electrical h. p. per car.

Perhaps the best proof that we have secured a good ground connection, and that we are receiving benefits therefrom, is the fact that we require no metallic connection in the return circuit between our power station and that portion of road now operated by electricity, a distance of about one mile.

When the road was first equipped by the Thomson-Houston Co. no ground connection was made, but two No. 0 American Gauge copper wires were strung overhead over this section for the purpose of carrying the current back to the generator. Tests made by us after we had connected our ground connection to the supplementary wire and track proved that we were deriving no benefit from these overhead return wires; we therefore, abandoned one of them and intend to make a feeder wire of the other.

The writer recommends perfect ground connections with the track and supplementary wire, and believes that it should be the aim of electricans to return the current to the generator in a path as direct and having as little resistance as possible. By the lower resistance encountered in the return portion, the total resistance to the current is very materially reduced, and economy of power, and efficiency of service in motors are gained.

A SIMPLE POLARITY TESTER.

BY ARTHUR J. NEWELL.

Having obtained, after considerable experimenting, a very convenient and cheap polarity indicator, the writer thought it might be of interest to some of your readers to know the results of the experiments.

If blue litmus paper, which can be bought in book form, for five cents, of any druggist, be immersed in a saturated solution of sodium sulphate, enough will be absorbed so that when the wires to be tested are brought into contact with the paper, the sodium sulphate will be decomposed. The alkali formed at the negative pole will produce no effect on the litmus, while the acid at the positive pole turns the blue litmus red. Therefore the rule for the use of this paper would be: The wire leaving a red spot is the positive pole of the circuit. If, however, an excess of acid should have caused the entire paper to become red, the converse of this rule would be true, viz., the wire leaving a blue spot is the negative pole.

After the paper has been immersed a short time it can be dried and carried about in the pocket. All that is necessary to again prepare it for use is simply to wet it.

One volt is enough to effect a decomposition, and leave a spot upon the paper, and the writer has tested it on circuits of 125 volts, and there is no reason why it could not be used on any voltage, if only a small portion of the wires be allowed to touch the paper and they are separated a sufficient distance.

The writer is confident that all who try this method will find it both convenient and reliable, as it avoids the use of any apparatus or dangerous chemicals.

NEW ELECTRIC ELEVATORS AND HOIST.

THE compactness and simplicity, as well as the economy of the electric motor when applied to the operation of elevators and hoists seems destined to lead to its general adoption for such purposes. In seeking to utilize the electric motor for this class of work, the American Electric Elevator Co., of this city, have recently brought out several designs which embody a number of novel and valuable features.

As the entire machinery occupies a floor space of only 4x6 feet, and stands only 4 feet high, it permits of being placed with equal readiness either at the bottom or at the top of the elevator shaft. The arrangements adopted in both these cases are shown in the engravings, Figs. 1 and 2.

The entire apparatus comprises merely the motor that drives a drum through the medium of a worm gear. To this is added the proper regulating and safety devices, consisting of a reversing switch and rheostat combined, an automatic electric brake, and an automatic stop device for stopping the elevator at the top or bottom of the lift, thus making it impossible for the elevator car to travel too far in either direction. The armature shaft of the motor is coupled direct to the worm shaft, and this coupling is also a brake wheel, to which the brake is applied automatically when the current is cut off. The brake shoes, it will be noted, are connected to the core of a solenoid, mounted directly above the shaft. When current is on, the solenoid is energized and the brake shoes are released. But a stoppage of the current from any cause, drops the core and applies the brake. This not only serves the purpose of overcoming the momentum of the armature when stopping, but also serves to hold the car stationary, if through accident at the generating station, or from any other cause, the current should be cut off.

The worm actuates the worm gear which is attached to the drum shaft. The wheel to which is attached the operating rope, and the movement of which starts, reverses or stops the car at the will of the operator, is also mounted on, but not fixed rigidly to the drum shaft. The end of the drum shaft has a screw thread cut on it, upon which there travels back and forth a nut provided with wings; hence, the nut, when it meets with any obstruction, turns with the drum shaft, and is so attached to the operating wheel by means of the wings, that it turns the wheel just enough to stop the motor. The necessary obstructions to the travel of the nut are in the form of collars which are fastened to the shaft at just the right place to stop the machine at the top and bottom of the lift. The worm, which is one piece with the worm shaft, is made of hard machinery steel, and

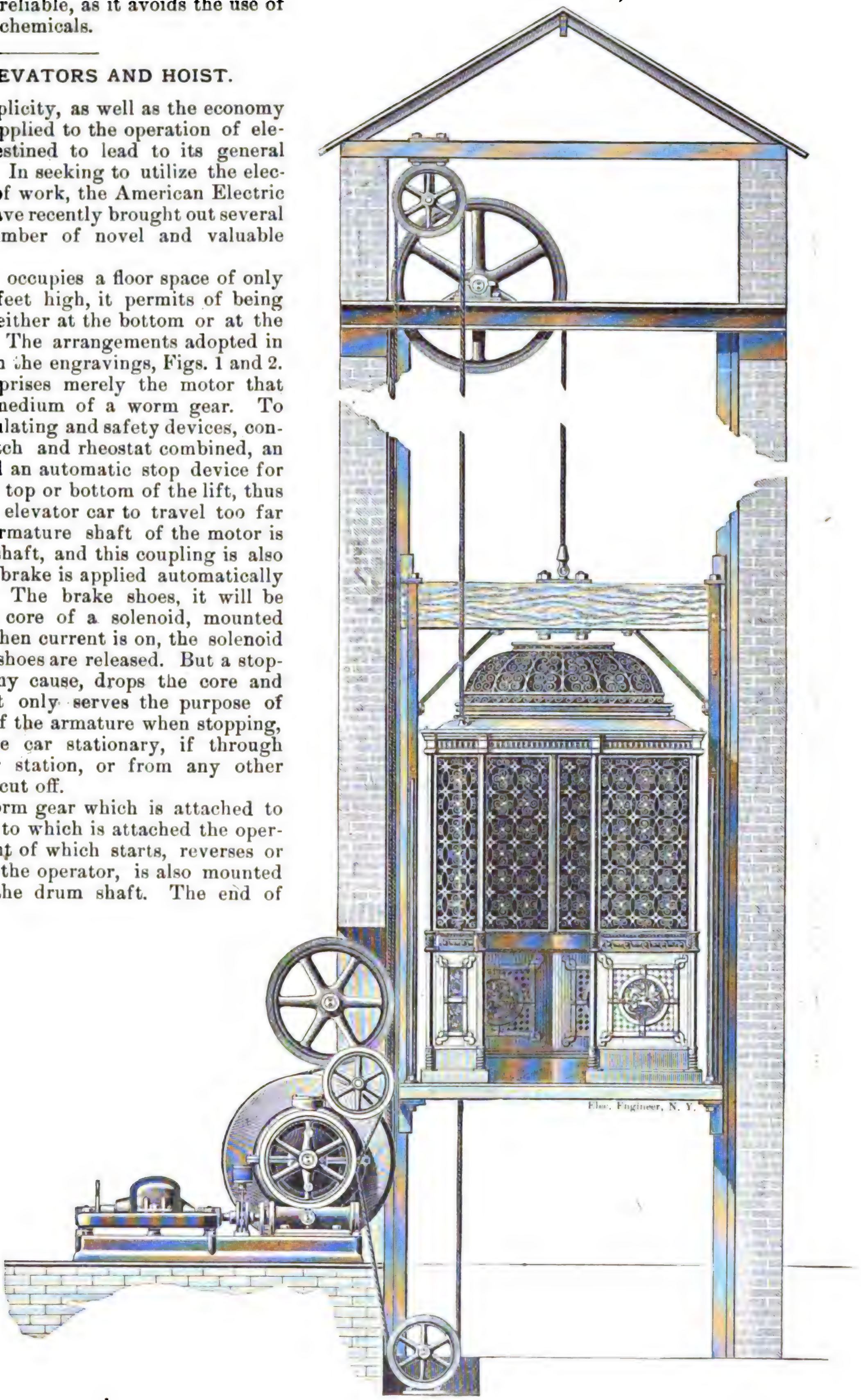

FIG. 1.—"AMERICAN" ELECTRIC ELEVATOR—MOTOR AT BOTTOM OF SHAFT.

the worm gear is a bronze composition ring which is securely fastened on a cast iron web, both being run in oil.

The whole machinery is assembled on one bed plate, and

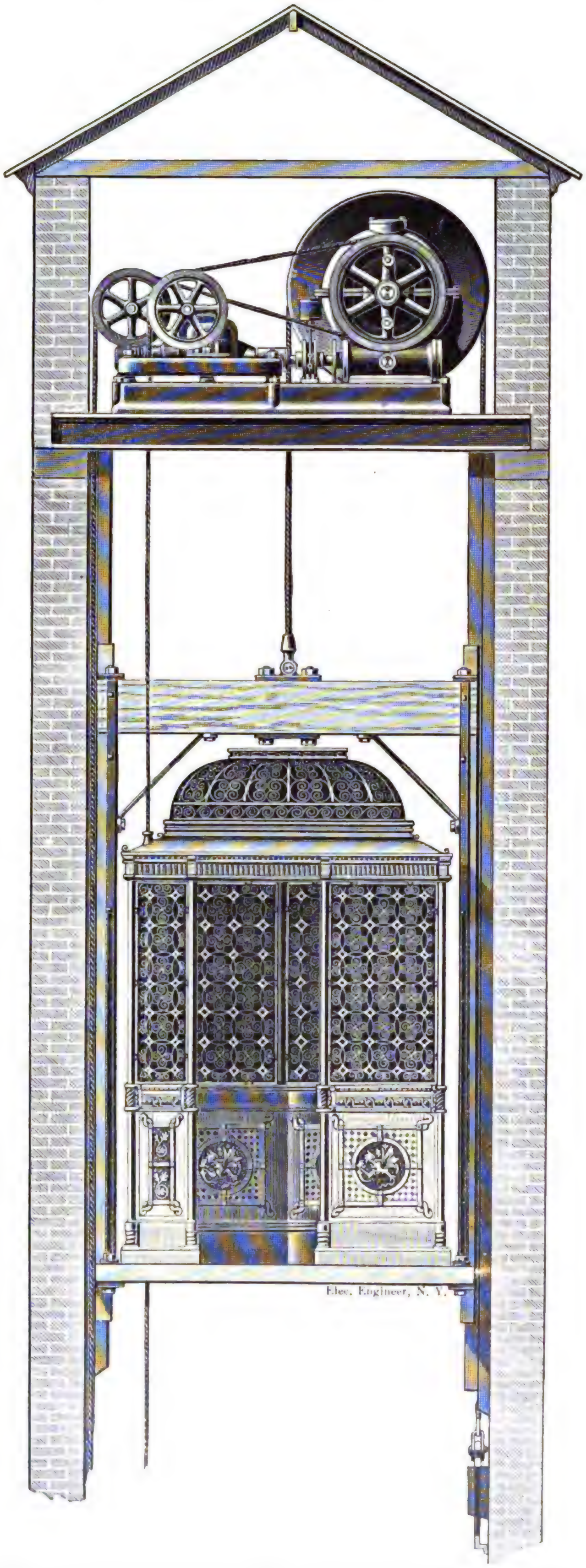

FIG. 2.—"AMERICAN" ELECTRIC ELEVATOR—MOTOR AT TOP OF SHAFT.

hence its erection and fitting in place can be effected with the least amount of difficulty and in the shortest possible time.

In carrying out the application of the electric motor to the handling and lifting of freight, the same company have brought out a new dock and ship hoist, which has some decidedly interesting features. The 10 h. p. hoist, which is illustrated in perspective in the accompanying engraving, Fig. 3, is assembled upon a bed plate 5 ft. 10½ in. by 2ft. 9½ in., and from the bottom of the bed plate to the highest point on the machine (the switch lever when in a vertical position) is but 3 ft. 7½ in. On account of its great compactness it may be placed on an overhead platform if desired, so that it occupies no dock or deck room whatever.

The engravings, Figs. 4 and 5, show the hoist in plan and side elevation, and Fig. 6 shows a section through the drum shaft.

The apparatus consists of an electric motor A, coupled direct to the armature shaft of which is a worm shaft C, which, with the worm, is one solid steel forging. This worm actuates a bronze worm gear D, and cast iron friction clutch E, which is attached to a solid steel shaft F. To one end of this shaft is attached a hauling drum or winch-head G, and on the other end there is cut a thread. On this thread is mounted a cast iron nut and handwheel H, which is supplied with steel handles on the inside of the

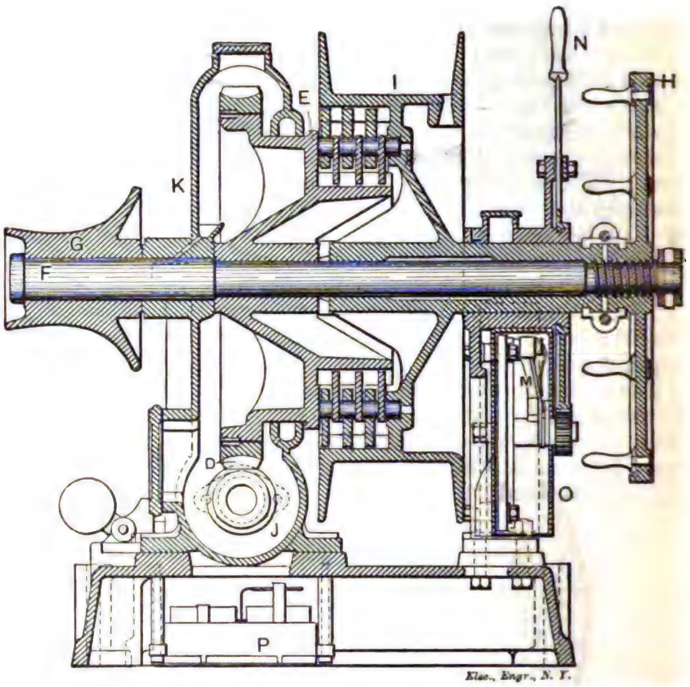

FIG. 6.—NEW ELECTRIC DOCK HOIST—SECTION.

rim; these are so placed in order that they will not catch in the clothing of, or strike, the operator. The movement of this handwheel-nut forces the loose drum I, into contact with the friction clutch E, or withdraws it, at the will of the operator.

The worm runs in an oil cylinder J, and the worm gear is enclosed in a cast iron casing K, which forms a bearing for the drum shaft F. The standard L which carries the other end of the drum shaft, also carries the switch M and the switch lever N. The switch is completely inclosed in a cast iron box O, which excludes all dust and dirt, and prevents bodily contact with it. The rheostat or resistance box P, is placed inside the bed plate, and the connections are so made that there are no wires in sight, and injury to the wires is, therefore, entirely avoided.

The manner in which the hoist is operated will now be plain. The operator moves the switch handle N to the left, which completes the electrical circuit and starts the motor; and as he continues to move the lever to the left he cuts out more resistance until full speed or the speed desired is attained. The drum shaft, winch-head and handwheel-nut are now in motion, but the drum is still at rest.

The winch-head G, alone may now be used; but if it is desired to use the hoisting drum F, the operator places his hand upon the hand-wheel H, and holds it stationary, which has the effect of screwing the wheel against the hub of the drum I, and thus forcing it into contact with the friction clutch E. When the pressure is sufficiently great to enable the drum to hoist the load, the operator is no longer able to hold the wheel, which then turns with the drum until the load is lifted to the desired height; the machine is then stopped by throwing the switch lever back to a vertical position, thus breaking the circuit and stopping the motor. The worm gear now holds the shaft with the friction clutch stationary, and the possibility of the worm being driven by the load is prevented by an automatic brake Q, Fig. 4, on the worm shaft. The handwheel H is connected with the hub of the drum I in such a manner that while each can turn independently of the other, the drum is moved back and forth on the shaft, as the wheel is turned on the thread.

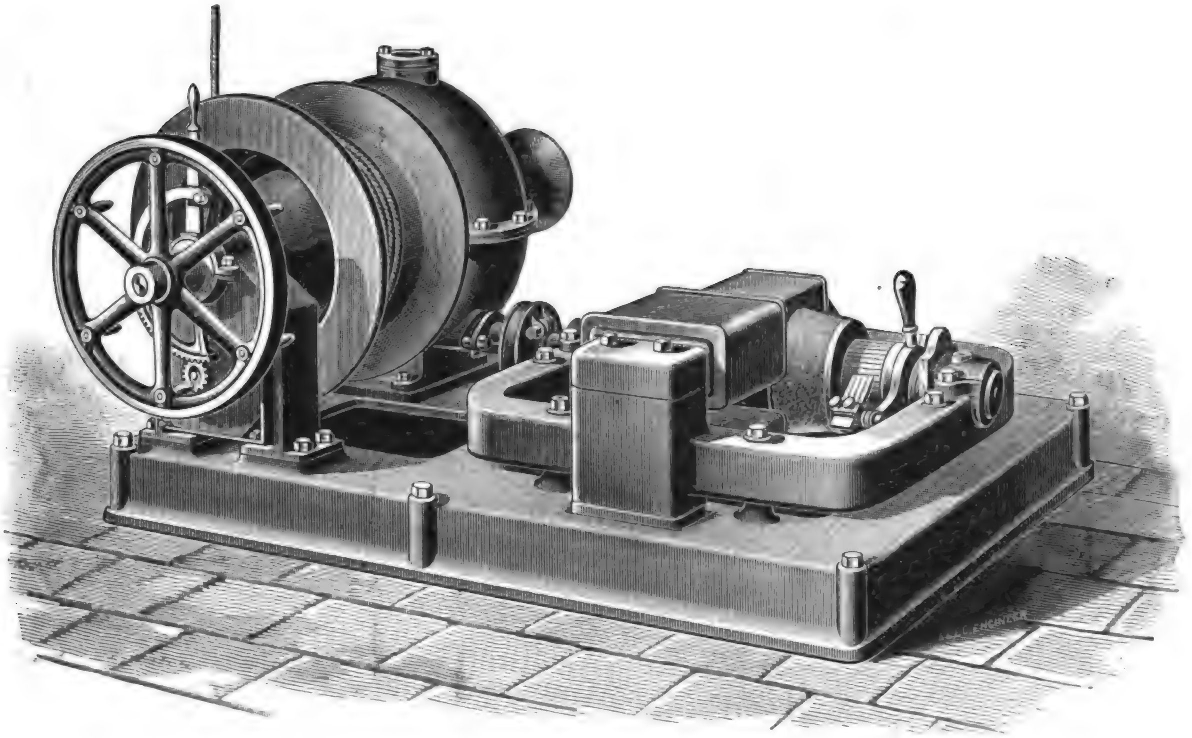

FIG. 3.—NEW "AMERICAN" ELECTRIC DOCK HOIST.

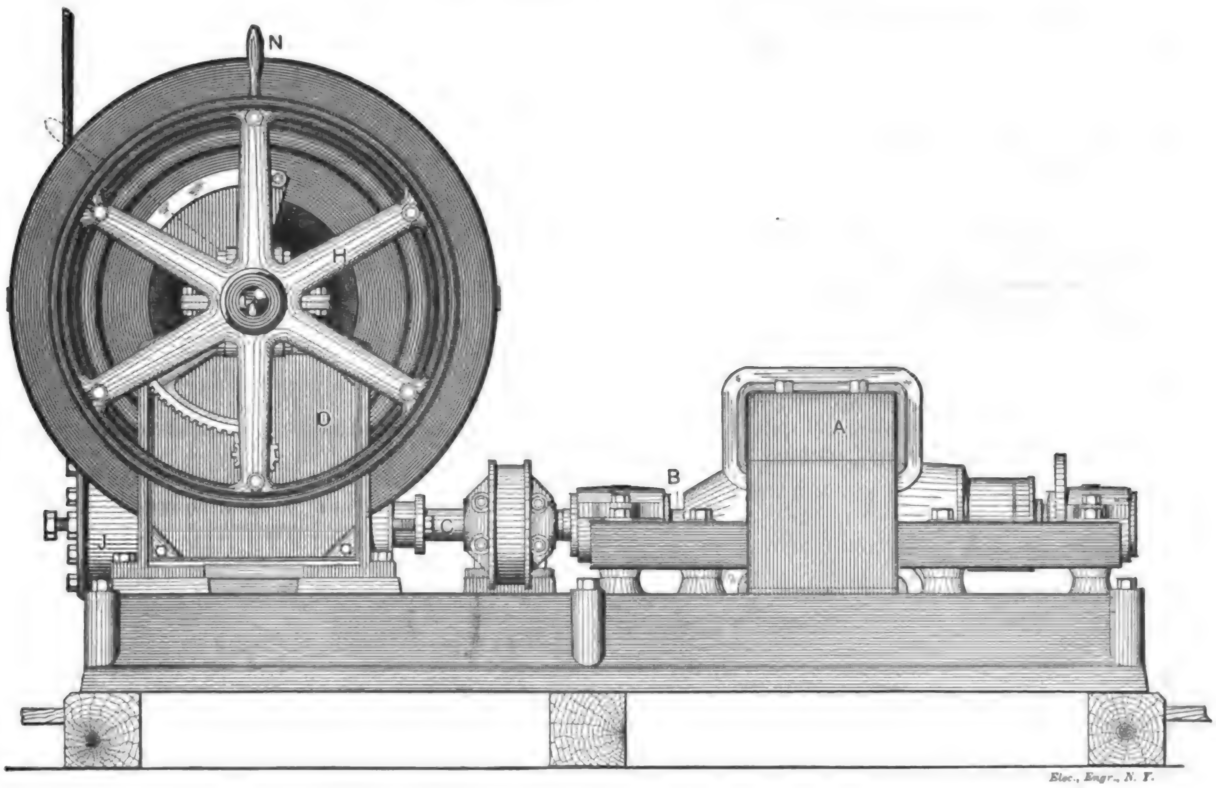

FIG. 5.—NEW ELECTRIC DOCK HOIST—ELEVATION.

To lower the load the operator moves the wheel H so as

to withdraw the drum I from the friction clutch E until the load begins to descend by gravity, and the speed of the descent is governed to a nicety by the handwheel. The positive connection between the handwheel and the drum is pointed out as an improvement over the more common one of having the drum forced out of contact by means of a powerful spring, for with the latter arrangement, there is always a possibility that the spring will fail to work; besides which the operator always has the spring working against him in applying the friction.

In addition to the apparatus described above, the American Electric Elevator Co. have a variety of others adapted to the numerous special cases which are met with in this class of work. Our readers will also be interested in the fact that the entire electrical work of the company is carried out by the Thomson-Houston Co., who, indeed, have practically turned over this entire department of their motor work to the Elevator Co.. All the non-electrical equipment is constructed by the Trenton Iron Works.

The Elevator Co. expect shortly to bring out a complete set of electric pumps to be used in connection with hydraulic elevators. We may add that Mr. G. H. Reynolds, the well known designer of the Reynolds-Corliss engine, is the general manager of the new company.

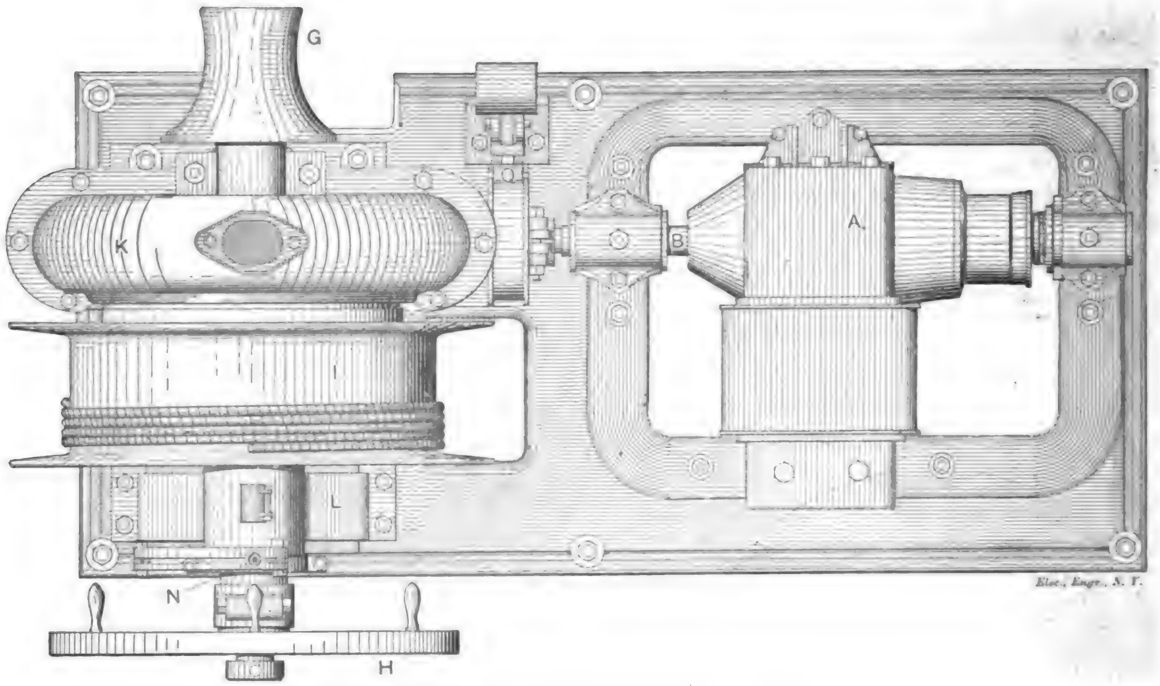

FIG. 4.—NEW ELECTRIC DOCK HOIST—PLAN.

THE JARMAN ACCUMULATOR.

IN connection with his system of storage traction, Mr. Jarman, of London, intends shortly to bring out a new storage cell. The active material is made of a mixture of hyposulphide of lead, acetate of lead, and a small quantity of litharge. This is cast in blocks and cut by a saw into squares. The carrier is made of an aluminum-lead alloy, cast round sets of suitably arranged blocks of the active material. This accumulator, he thinks, will be able to be made at half the cost of the present cells. The solution for the accumulator is an acid solution of alum—the double sulphide of alumina and potash.

Mr. Jarman has also perfected a connection lag which will not burn out. For this he takes a thick solid piece of copper rod, tinned on the exterior and tapped at both ends. This, when the ends are bent up, is cast round with lead and thoroughly embedded therein. The two ends form a double contact, on which nuts can be screwed down on the connecting piece with a lead washer so as to be secure even if one end fails.

SOME PRACTICAL METHODS FOR THE DETERMINATION OF INDUCTIVE RESISTANCES AND SELF-INDUCTION OF ALTERNATE-CURRENT INSTRUMENTS.—I.

BY CHAS. STEINMETZ.

SINCE the system of distributing electricity by alternating currents and transformers has found such manifold applications, terms formerly rarely used, such as self-induction, retardation, etc., have come into general use, and determinations of inductive resistances, and of coefficients of self-induction of measuring instruments, will soon be carried on as every-day work.

Now, the instrument mostly used for the determination of self-induction and mutual induction is the ballistic galvanometer. But not only is this instrument generally too delicate for the unstable floor of an electric factory, but it has the disadvantage that its readings very often cannot directly be applied for the alternating currents of our machines.

Another but more simple method for the determination of self-induction I shall give in the following, being a method which requires no other apparatus but an alternate-current voltmeter and ammeter—instruments available in any electric factory which is building alternate-current apparatus.

This method will be specially adapted and convenient when the self-induction is of a similar value, or even greater, than the true electric resistance.

A.—DETERMINATION OF THE COEFFICIENT OF SELF-INDUCTION OF AN INDUCTIVE RESISTANCE.

To find the coefficient of self-induction of an inductive resistance (induction coil, transformer, etc.) I connect the inductive resistance to be determined, in series with an alternating current ammeter, and connect an alternate current voltmeter in shunt to ammeter and inductive resistance.

Let $r =$ the electric resistance of the ammeter;
$l =$ the coefficient of self-induction of the ammeter;
$R =$ the true electric resistance of the induction coil, the coefficient of self-induction of which is to be determined;
$X =$ the coefficient of self-induction.

Now, in sending an alternating current of known num-

ber of periods through this circuit, the current in the inductive resistance, read by the ammeter, may $= c$, and the difference of potential around inductive resistance and ammeter, read by the voltmeter in the shunt circuit, may $= p$.

Then the E. M. F., or potential, lost in overcoming the resistance of the ammeter, is: $e = r\,c$; the potential, lost in the resistance of the induction coil: $E = R\,c$.

Therefore, the E. M. F., or potential, lost in overcoming the whole electric resistance of this branch-circuit,

$$e + E = (r + R)\,c. \tag{1}$$

The E. M. F., due to self-induction in the ammeter, is

$$e^1 = \frac{2\,\pi\,l}{T}\,c,$$

as well known; and in the inductive resistance:

$$E^1 = \frac{2\,\pi\,X}{T}\,c,$$

where T = time of one full period. Therefore, the whole E. M. F. of self-induction in this circuit:

$$e^1 + E^1 = \frac{2\,\pi\,(l + X)}{T}\,c. \tag{2}$$

The impressed E. M. F., p, measured by the voltmeter, is the resultant of these two E. M. F.'s: $(e + E)$ and $(e^1 + E^1)$. But, $e + E$ has the same phase as the current c. $e^1 + E^1$ lags behind c by a difference of phase of exactly 90°.

Therefore, the resulting E. M. F. of $e + E$ and $e^1 + E^1$ is found by the law of the parallelogram of E. M. F.'s as the hypothenuse of a rectangular triangle, of which the cathets are $e + E$ and $e^1 + E^1$.

Therefore,

$$p = \sqrt{(e + E)^2 + (e^1 + E^1)}.$$

Or, substituting (1) and (2),

$$p = c\sqrt{(r + R)^2 + \frac{4\,\pi^2}{T^2}(l + X)^2}, \tag{3}$$

Therefrom we get the coefficient of self-induction of the inductive resistance:

$$X = \frac{T}{2\,\pi}\sqrt{\left(\frac{p}{c}\right)^2 - (r + R)^2} - l; \tag{4}$$

and the angle ω of shifting of phase by this inductive resistance:

$$\tan\omega = \frac{E^1}{E}.$$

Or, from (1) and (2),

$$\tan\omega = \sqrt{\left(\frac{p}{c\,R}\right)^2 - \left(\frac{r + R}{R}\right)^2} - \frac{2\,\pi\,l}{T\,R}. \tag{5}$$

When we can assume the approximation, $r = 0$, we get:

$$X = \frac{T}{2\,\pi}\sqrt{\left(\frac{p}{c}\right)^2 - R^2} - l. \tag{4a}$$

$$\tan\omega = \sqrt{\left(\frac{p}{c\,R}\right)^2 - 1} - \frac{2\,\pi\,l}{T\,R}. \tag{5a}$$

And when $R = 0$, too,

$$X = \frac{T\,p}{2\,\pi\,c} - l; \tag{4b}$$

$$\tan\omega = \frac{p}{c\,R} - \frac{2\,\pi\,l}{T\,R}. \tag{5b}$$

And, if the self-induction l of the ammeter can be neglected also:

$$X = \frac{T\,p}{2\,\pi\,c}, \tag{4c}$$

$$\tan\omega = \frac{p}{c\,R}. \tag{5c}$$

which formula will be found sufficiently exact in very many cases.

Therefore, for approximate determination of the coefficient of self-induction, if r and R are small, it is not necessary to know the electric resistance at all, and the current in the alternating circuit is almost entirely independent of the electric resistance, depending only on the impressed E. M. F. and the self-induction. But the energy absorbed by this circuit will nevertheless be proportional to the true electric resistance, *i. e.*,

$$W = c^2\,(r + R).$$

For the determination of small electric resistances, I consider as the most reliable method, to send a continuous current through them and measure current strength and potential.

Let the continuous current in the circuit of ammeter and inductive resistance $= c_0$, the potential difference $= p_0$.

Then we have:

$$p_0 = (r + R)\,c_0; \tag{6}$$

and by substituting this in formulas (4) and (5), the coefficient of self-induction:

$$X = \frac{T}{2\,\pi}\sqrt{\left(\frac{p}{c}\right)^2 - \left(\frac{p_0}{c_0}\right)^2} - l; \tag{7}$$

and the shifting of phase by it;

$$\tan\omega = \frac{1}{R}\sqrt{\left(\frac{p}{c}\right)^2 - \left(\frac{p_0}{c_0}\right)^2} - \frac{2\,\pi\,l}{T\,R}; \tag{8}$$

or, if r and l can be neglected:

$$X = \frac{T}{2\,\pi}\sqrt{\left(\frac{p}{c}\right)^2 - \left(\frac{p_0}{c_0}\right)^2}. \tag{7a}$$

$$\tan\omega = \sqrt{\left(\frac{p}{c}\cdot\frac{c_0}{p_0}\right)^2 - 1}. \tag{8a}$$

This method has the feature of eliminating the resistance of the connecting wires, which, when the main-resistance is small, cannot well be neglected.

As an instance I shall give the following test made by me some time ago on an inductive resistance.

The resistance of the ammeter, an electro-dynamometer, with one turn as the movable circuit, was,

$$r = .01 \text{ ohm};$$

its coefficient of self-induction,

$$l = .000066 \text{ henry}.$$

The alternate current was produced by a small Westinghouse dynamo, giving 100 complete periods per second; therefore,

$$T = .01 \text{ second}.$$

The continuous current was derived from an Eickemeyer storage battery. Another storage battery was feeding the field of the alternator.

The readings were:

Continuous current:

$c_0 = 26.40$ amperes; potential: $p_0 = 1.742$ volt.

Alternate current:

$c = 16.62$ amperes; potential: $p = 31.01$ volts.

Therefore, the coefficient of self-induction, by formula (7):

$$X = .002902 \text{ henry};$$

and the electric resistance:

$$r + R = \frac{p_0}{c_0} = .066 \text{ ohm};$$

and since

$$r = .01 \text{ ohm},$$

therefore,

$$R = .056 \text{ ohm}.$$

The angle of shifting of phase, by formula (5), was:

$$\text{angle } \omega = 88.15 \text{ degrees}.$$

Formula (4*b*) gives,

$$X = .002904 \text{ henry}.$$

And (4*c*),

$$X = .002970 \text{ henry}.$$

In considering that the exactness of the test was limited by the inconstancy of the speed of the alternator, which, driven by an ordinary steam-engine, fluctuated by more than 2 per cent., the approximate figure, .002904 henry, and even .002970 henry, could be considered exact enough for most purposes.

THE NEW LAW CABLE HEAD.

The general introduction of underground cable work for telegraph and telephone purposes in our large cities has taxed the ingenuity of electricians to the utmost to devise not only suitable conduits but many minor devices

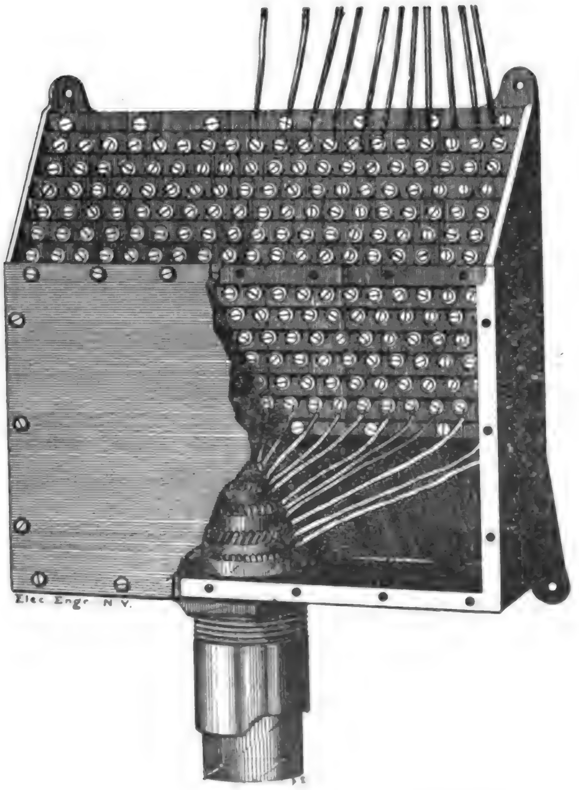

Fig. 1.—New Law Telephone Cable Head.

upon which the successful working of underground conductors depends.

In the case of telephone circuits, for instance, these are, as a rule, run underground in various lengths and distributed from poles. This requires the cable to be led from the conduit up the side to the top of the pole. Or, again, on entering the exchange from the conduits the cables are brought in and then carried to the distributing board. In either case, it is important that the arrangement be such that while the wires constituting the cable shall be easily accessible for making connections, the end of the cable proper shall be sealed so that moisture is entirely excluded.

Past experience has shown that the entrance of moisture for but a few feet from the end of a cable reduces the insulation enormously, and may completely vitiate good service which might otherwise be obtained from the same cable in proper condition.

The effort to obtain a device which shall afford ready

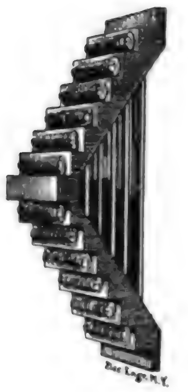

Fig. 2.—Interior View of Law Cable Head.

access to the conductors and leave the cable intact has resulted in a variety of what are known as "cable-heads." A recent departure in this direction, and one which merits attention on account of its simple and ingenious construction is that invented by Mr. W. H. Balsby, of the Bell Telephone Co., of Philadelphia, now being made by the Law Telephone Company, of this city. A large number of these heads are being installed in connection with the "Law" switchboard in Philadelphia.

The cable head, which is illustrated in perspective in the engraving, Fig. 1, consists of a cast iron box, the back of which is extended beyond the sides. Mounted upon this back is a hard rubber frame upon which the terminals are fixed, each set being raised a short distance above the other and sloping away from each other, as clearly shown in Fig. 2. It will also be noted that each terminal on one side of the slope is connected by a brass strip with a corresponding terminal on the other slope.

By the construction adopted one set of these terminals is enclosed by the sides of the box into which the cable leads and to which the cable conductors are attached.

After the connections with the cable conductors are made, the box is sealed by a cast iron cover and screwed down upon a rubber gasket making a perfect joint. In this way all moisture is excluded. This leaves the upper tiers of terminals free for connection to the distributing wires.

The hard rubber frame upon which the terminals are mounted evidently leaves an air space between it and the rear wall of the box, and to prevent the entrance and accumulation of moisture, as well as to thoroughly insulate the brass connecting strips from one another, the entire space is filled up with black "battery wax." This is applied by pouring it in while hot through a hole in the rear of the cast iron box.

The cable head illustrated is designed for 119 circuits and is exceedingly compact while at the same time so constructed that the wires can be easily got at.

NUMBER OF TELEPHONE SUBSCRIBERS ABROAD.

In Germany the telephone subscribers are estimated to number 31,325; in France, 9,487; in Great Britain, 20,426; in Russia, 7,585; in Italy, 9,183; in Austro-Hungary, 4,200; in Spain, 2,218; in Portugal, 890; in Switzerland, 6,570; in Belgium, 4,674; in Netherlands, 2,872; in Denmark, 1,837; in Sweden, 12,864; in Norway, 8,390.

ELECTRICAL ENGINEERS.

FRANCIS R. UPTON.

THE subject of this biographical sketch was born July 26, 1852, at Peabody, Mass., of an ancestry and stock New England in every branch for over 200 years. His father, a leading business man in that place, was a friend of Peter Cooper and George Peabody, and his mother is a public spirited woman, for many years at the head of various local charities. Mr. Upton's education began in Phillips Academy, and Chauncey Hall, Boston, and continued in Bowdoin College, where he was very active in undergraduate matters, being editor of the college paper, commodore of the Boat Club, etc. A speech delivered at the time of his graduation attracted notice and was quoted in several newspapers. His education, so far as American training went, was completed at Princeton, where he took the degree of M. S.

Being devoted to Physics, and feeling the need of supplemental work, Mr. Upton then went to Germany and spent a year studying in the laboratory at Berlin, under Helmholtz. While there, he earned money for the first time in a somewhat singular and striking manner. When going to lunch in the middle of the day, he noticed the Emperor William's carriage being driven away rapidly from a fast gathering crowd. Then policemen came out of the throng dragging the man Hodel, who had attempted to take the life of the Emperor. Young Upton naturally made inquiries about the matter and soon picked up enough information to satisfy him that he had happened upon a very important piece of news. Possessing himself of the facts, he jumped into a vehicle and rushed off to the Central Telegraph office, writing a telegram to the *New York Herald* as he went. Of course there were difficulties in the transmission of political intelligence, but by golden persuasion the telegram was put through. It was the first news out of Berlin of the occurrence, and the first to reach America. Mr. Upton made $90 over expenses by this little display of his ability to earn a living as a newspaper man.

Francis R. Upton.

On returning to America, Mr. Upton at once sought out practical work, and in 1878 entered the employ of the Gold & Stock Telegraph Company, to learn the telephone business. Through the friendship of Howard R. Butler, to whom the position had been offered, he became associated with Mr. Edison, as his mathematician, to calculate various electrical problems, and thus entered an entirely new field of work, in which not only mathematics but every other accomplishment and quality were needed. He was with Mr. Edison during the memorable experiments in electric lighting at Menlo Park, worked hard day and night, and, together with Mr. Charles Batchelor, became interested with Mr. Edison in his inventions on the basis of a percentage of the profits. It was about this time also that Mr. Upton contributed to the old *Scribner's Monthly* that highly interesting article on the electric light, which has since become historical and has perhaps been more often reprinted and referred to in litigation proceedings than any other article of the same kind. It is worthy of note that the first carbon filament lamp burned outside the laboratory was lighted in Mr. Upton's house at Menlo Park, as, by luck, the line to his house was the first to be finished. It also fell to Mr. Upton's lot to place the first two of the present type of high resistance lamps in multiple arc across the circuit from a low resistance armature. This showed that either lamp could be lighted without making the other flicker appreciably.

In 1881, Mr. Upton took charge of the Edison Lamp Factory, and he has remained in direction of that important branch of the Edison industries down to the present time, witnessing an enormous development of the business, and initiating and superintending many changes looking to the perfection and cheapening of processes. Mr. Upton has in the meantime been interested in electrical and business enterprises and has himself brought out various inventions.

Owing to the pressing nature of his professional engagements, Mr. Upton has had little time for public engagements, but he has served actively as Vice-president of the American Institute of Electrical Engineers, and been invited to stand for election as President.

ELECTRIC TRACTION IN BUDAPEST.

THE Budapest Electric Railway, which was built by Messrs. Siemens and Halske, on the underground-conductor system, has proved a decided commercial success. Some 20 cars run on the line, the length of which is 7.9 kilometres. The line passes through the most fashionable streets of the town. During the month of April, 337,200 passengers were carried, being at the rate of 42,684 per kilometre of line, and 16,860 per car. The horse lines in the same town, which have a total length of 45.6 kilometres, and 329 cars, carried in the same month only 33,074 passengers per kilometre, and 4,854 per car. The earnings for the month were, for each electric car, $500; for each horse car, $175. Since the date of this return, it is said that the differences in favor of the electric lines have been still further increased. The greater speed attained by the electric cars (11 miles per hour, as against 5) is no doubt responsible to a great extent for this flourishing state of affairs. The Town Council has also recently given permission for the building of a small electric line on the Zipernowsky single track system. An experimental length of 3 kilometres, from Messrs. Ganz's factory to Steinbruch, is at present being laid down. In spite of the disaster at Florence, caused by the drunken driver, and the general slowness in adopting electricity, there seems reason to believe that, overhead systems being in disfavor, the conduit and storage methods are about to enjoy a large measure of prosperity in Europe, although it may be doubted whether electric railway development there can catch up to that already seen in America.

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The science of electrical engineering is now recognised as one of the most necessary practical sciences of the world.—Lieut. B. A. Fiske, U. S. N.

ELECTRICAL ENGINEERING AND ELECTRICAL INVESTMENT.

MORE emphatic testimony to the pecuniary value of good electrical engineering has not been given anywhere than will be found in Mr. B. E. Sunny's thoughtful and suggestive paper, read before the Chicago Electric Club and printed in our columns this week, on the central lighting station as an investment. The financial questions connected with electric lighting are well worthy of consideration by themselves, and have their own aspects; yet, after all is said and done, it is striking how they narrow down generally to points that interest very directly the electrical engineer.

Who can deny, for example, Mr. Sunny's assertion that "the face of the earth is dotted with lighting properties which were poorly planned, badly built, and indifferently managed;" and that "we can all point out a long list of stations located in cellars, basements, abandoned barns, and cheap wooden structures," with an equipment cheaper, if possible, than the buildings they run in? It is only too true; and it is equally true that in every one of these instances the electrical engineer was conspicuous by the contempt in which he was held whenever he ventured to propose an improvement.

Another class of stations referred to by Mr. Sunny is that in which it has been necessary almost from the start to launch out in a series of extensions to keep pace with the business, until at last the station with its varied equipment has come to resemble an electrical museum, a place where the absence of "system" is shown by the presence of too many of them. Here again the low regard of the practical layman for the electrical engineer is evident, for while the engineer has short-comings of his own, he is generally influenced by his training in favor of doing a thing largely, broadly and well, and against practices that prevent him from detecting just where undue expenses arise, or from operating with the best economy. No one will be quicker than the electrical engineer to endorse Mr. Sunny's remark that "the whole secret of dividend paying enterprises is in their ability to run reliably, every day and every year, without subjecting the machinery to excessive and abnormal demands and in the avoidance of rebuilding or abandoning the original investment."

One thought that comes up on reading Mr. Sunny's paper is that the central station as an investment in many places will yield better returns than it has by being given all the work it can do, so that its load line is a pretty straight one the day and night through. To establish a number of little stations in a small, or even a large town is a mistake. The labor item is among the heaviest, so that the distribution of this charge over a variety of services by operating them all under one management is distinctly in the direction of higher profit. There is a point at which the cost of management of such a combined plant again cuts down the saving, but in hundreds of instances it would pay to throw all the electrical services of lighting, stationary motors, and railway work into one set of hands.

We have just mentioned stationary motors. Here is a means of increasing the return on the central station investment that, to our certain knowledge, has not even been touched by large numbers of managers and superintendents. Few of them have, so far, made a systematic canvass of their territory to discover how much power current they could sell, and how many motors they could place. Yet these motors, all the year round, are a source of income, and in summer time, when lighting patronage drops off, they come in as an admirable means of keeping the income up to a decent average. The study of ways for increasing the earning capacity of a station has not yet been reduced to a fine art.

Then, stations ought to have more measuring instruments than they now possess. So long as a station is simply running some arc lamps, strung along on a clothes line, the necessity of ammeters and voltmeters may appear small; but the moment a station begins to discharge its mission and live up to all its opportunities, its managers must know its exact output, just as they check its exact income. It seems the easy way to sell current on a flat rate, but there is more money in getting a definite price for definite service. As Prof. John Trowbridge once said: "The difference between the scientific man and the unscientific man is, that one makes accurate measurements, while the other is satisfied with general knowledge, and does not ask 'How much.'" The odds are all in favor of the station that weighs its coal by the scale and sells its current by the meter.

PRACTICAL EXPERIENCE WITH ELECTRIC CARS.

The report on electric motive power made by Dr. W. L. Allen, at the Street Railway Convention, and printed in our last issue, deserves attention as coming from those who have had practical experience with both horse and electric railway work, and because the report is written with an evident spirit of fairness. The hints which are thrown out as to the direction in which improvements are desirable concern the mechanical as well as the electrical engineer. While the electric railway operator may learn, and has learnt, much from the electric light station operator, the former's work differs in many important respects from that of the latter and especially with regard to the character of the load. The extremely violent fluctuations in load met with in railway work make the choice of a proper type of engine one of considerable difficulty. In the matter of the present modes of construction the report points out some changes which are desirable in the material employed in effecting a good ground return, galvanized iron rail bonds and return wire being suggested in place of the copper at present employed. We think the experience which has dictated this suggestion sufficient to warrant its general adoption, so far, at least, as bare copper wire is concerned. On the subject of repairs to motors and gear generally it cannot be denied that these appear to be heavier than seems necessary, and their reduction is the most important problem which confronts the electric railway engineer to-day. Some of the means by which this can be effected have already been pointed out by us; it will be noted as significant, however, that the number of cars disabled electrically was far less than those mechanically incapacitated. In spite of these short-comings, however, which are destined to be remedied in a short time, the report is an unqualified endorsement of electric motive power; and it may be added that the testimony of many present went to show that the general average for repairs is enormously below Dr. Allen's figure on a pioneer plant.

LOWER PRICES FOR INCANDESCENT LAMPS.

In commenting recently upon the relative positions occupied by the metals in the electric arts at the present day, as compared with but comparatively few years ago, attention was drawn to the fact that the cost of one item alone in the manufacture of the incandescent lamp, namely, that of the platinum leading-in wires, had increased from 3 cents to 8½ cents. It might by some be supposed, therefore, that on the whole the cost of manufacture of incandescent lamps had been materially increased; but a glance at the past history of the ruling prices for incandescent lamps will show that, on the contrary, the increased number of lamps made and used during the past few years has brought about a constant reduction in the price. Many of our readers will remember that when the incandescent lamp was first introduced the price ranged in the neighborhood of $1, and remained so up to 1887. In that year a reduction was made bringing the cost to consumers down to 85 cents. This was again reduced during 1889 to 75 cents and somewhat below that even; but we are free to say that few would have anticipated that the present year would see 16 c. p. incandescent lamps selling at 44 cents. Yet such is now actually the case.

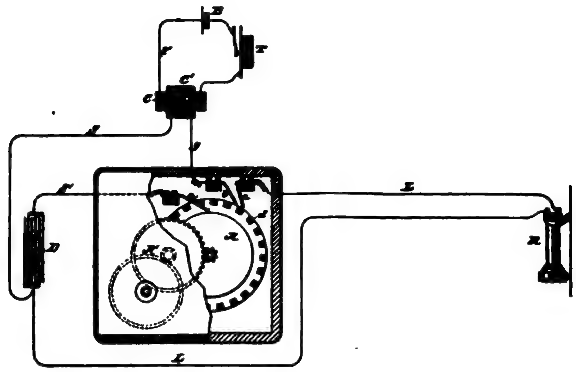
The question might naturally be asked, how such a considerable reduction is possible, and whether it still leaves a fair profit to the manufacturer. It is safe to answer the latter question in the affirmative, and if we seek for the causes which have made this reduction in the price possible, we must look to the improvements which result from experience in the manufacture of any article in large quantities. Thus as time has passed since the beginning of the art, probably the most expensive part of the lamp, if we may be allowed to use the expression, the vacuum, has been largely reduced in cost of production by improvements in exhausting apparatus, pumps, etc. Again, the introduction of machinery for cementing the filaments to the leading-in wires and for other purposes has not only reduced the cost of manufacture directly but indirectly, on account of the reduced amount of breakage, which, with the old methods, involved a considerable percentage of loss. There can be no question that this considerable reduction in the price of incandescent lamps will lead to the manufacture and consumption of an increased number of lamps. It will without doubt also be followed by a notable change in the methods of operation of many central stations and perhaps private plants. With the cheaper lamp, it is evident that the life is not as important a factor in the cost of operation as formerly; so that lamps may be run at a higher candle power and be more economical in the use of current than was desirable in the past. There is, therefore, every reason to believe that the lowering of the price of incandescent lamps will not only give us more of them, but will tend to brighten them, and this again will lead to greater demand for them. Such reasons were doubtless the determining ones with the manufacturers in making such an appreciable reduction in price at a moment when almost everything has an upward tendencyin the market as the result of the new tariff.

The U. S. Electrical Corps.

Some months ago, Mr. Frank Stockton, in one of his characteristic stories, told how a great sea war waged by this country was carried on and won almost wholly by novel electrical apparatus and appliances. Wild as his fiction seemed to many people, the novelist did but mildly exaggerate the rapidity with which electricity is coming to the front as an agency in warfare. The fact is, the modern army or navy officer who is not as expert in electricity as in navigation or in military tactics is only half trained. This truth has been seen by Lieut. Bradley A. Fiske, who, in his excellent paper read last week before the New York Electrical Society, advocated not only that the electrical education of officers should be thorough and complete but that an electrical corps should be formed which could be called upon in case of the outbreak of a war to assist in handling ships and forts with the electrical devices and machinery already so indispensable and multiplying daily. The idea is a good one, and meets a condition of things that, unless dealt with in some such manner, might result in all the injustice and reproach recorded in the history of the U. S. Military Telegraph Corps. That body, a purely voluntary one, rendered great services during the war, yet it has never met with any recognition, even of a merely formal nature.

McDONOUGH'S NEW TELEPHONE SYSTEM.

Mr. J. W. McDonough, one of the early inventors in the field of telephony, has just received a patent for an elaborate and ingenious method of transmission. He has sought to produce an effective transmitter, particularly applicable to long-distance lines, employing a continuous undulatory current in the local or primary circuit, includ-



McDonough's New Telephone.

ing the usual induction coil, and an intermittent current in the line leading to the receiver. The accompanying diagram illustrates the principle and method of operation of Mr. McDonough's method of transmission; L, L, representing a main line connected to an ordinary receiving telephone R. T is a transmitter acting on the usual microphone principle, with induction coil and battery in the local circuit.

The peculiar feature of the system consists in the use made of a condenser D and the metal disc A included in the secondary or line circuit. The periphery of the wheel or disc, which is rapidly rotated by a train of wheels or other mechanism, is serrated, having insulating blocks between the teeth. Two contact-springs *b c* bear upon the periphery of the wheel, and a third contact-spring *a* bears upon the side of the disc or upon the circular shoulder, in the manner illustrated. The contacts *b* and *c* are never in contact with the metal at the same time, but the spring *a* being always in contact with the disc, is brought alternately into connection with the springs *b* and *c*. One end of the circuit S, including the secondary C′ of the induction-coil, is connected to one of the contact-springs, *b*, and the other end to one of the terminals of a condenser D. Similarly the ends of the circuit L are connected, respectively, to the same condenser terminal and to the other contact-spring *c*. S′ connects the opposite terminal of the condenser with the contact-spring *a*.

In operation, the disc A is set in rapid uniform rotation. The secondary currents from the induction coil do not pass to the receiver, but flow into the condenser whenever the spring *b* is in contact with the metal teeth of the disc. When the spring *c* comes in contact with one of the metal teeth, the condenser is discharged into the main line.

According to Mr. McDonough, the time occupied in charging the condenser is that required for one of the metal teeth of the disc to pass under the spring *b*, and the strength of any charge will depend upon the character of the movement taking place in the instrument T; but the time required to discharge the condenser is much less than that occupied in charging it; the discharge being practically instantaneous whatever the strength of the charge, while the charging is gradual and consumes an appreciable period of time. It would follow that the current in line L would be made up of a succession of sharp, quick, and absolutely-distinct impulses formed by the condenser-discharges. At the same time it is found to reproduce in the receiver R the words or sounds directed into the transmitting instrument T.

A PRESSURE REGULATOR FOR STORAGE BATTERY PLANTS.

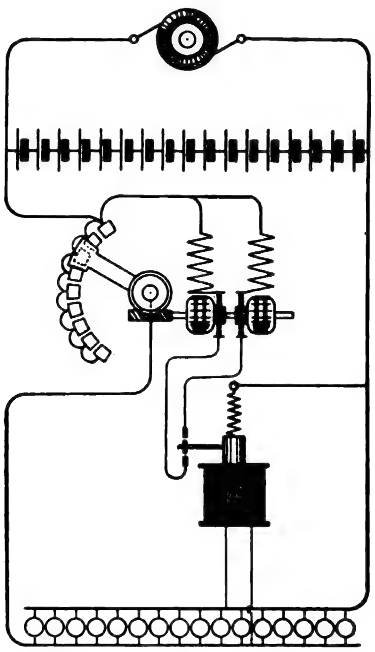
BY E. T. BIRDSALL, M. E.

In the October 1 issue of The Electrical Engineer there was described a method of regulating the pressure on the lamps in a storage battery plant. As the method somewhat resembles one devised by me, I give below a description of the latter. In the drawing, everything is shown diagrammatically; in the actual machine I would use a large high resistance relay operating mercury cup contacts.

Two motors are shown, but the contacts can be arranged to operate the rheostat with one motor. The rheostat contact arm should also break the respective motor circuits when the pressure, by any accident, cannot be controlled by the range of the rheostat.

It will be seen that this is a much modified form of the Goolden and Trotter governor, the motor or motors furnishing the power for operating the rheostat instead of the shaft usually employed, but which in private plants is seldom available. In the present case, the apparatus was designed for the engine and batteries, which were located several hundred feet from the lamps and rheostat and in separate buildings.

It will be seen that when the pressure on the lamp mains is at the proper point neither motor is in circuit. If the pressure for any reason increases, or diminishes, the



Birdsall's Method of Regulating Accumulators.

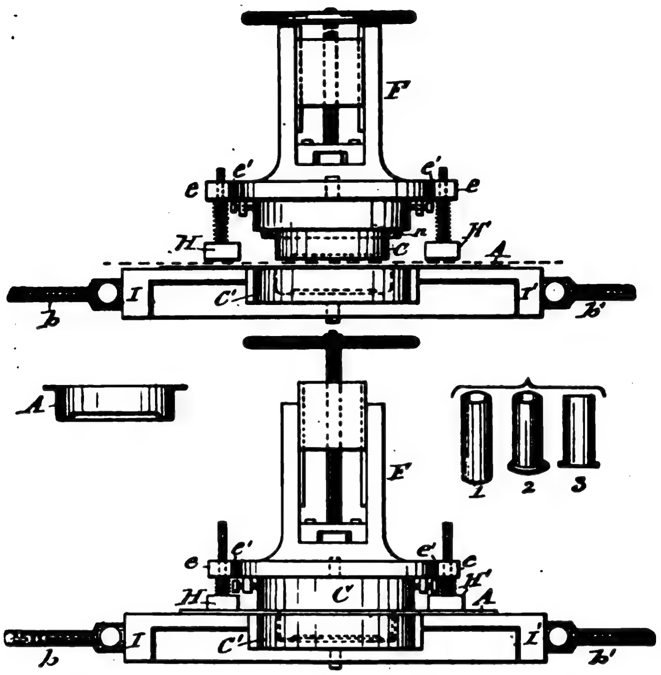
corresponding motor is put in circuit and the arm of the rheostat moved until the pressure on the lamp mains is once more at the proper point. It will be noticed that this arrangement requires no auxilliary batteries.

A RADIOMETER PHOTOMETER.

The well-known radiometer of Mr. Crookes has been adopted as a photometer by MM. Seguy and Verschaffel. The rotating disc is not pivoted, as in the Crookes apparatus, but suspended by a silk fibre and fitted with a scale and needle, after the manner of Coulomb's torsion balance. A glass containing a solution of alum is placed between the light to be measured and the rotating disc, so as to cut off the heat rays. The light rays in falling on the disc cause it to turn round through a certain angle depending on their intensity. Thus one light can be measured after another. The apparatus is stated to be so sensitive as to indicate the one-hundredth of a standard candle.

DEWEY'S ELECTRICAL SHEET METAL FORMER.

The introduction of electrical welding has served to direct the attention of inventors to the employment of electricity in other departments of metal-working. Among others, Mr. Mark W. Dewey, of Syracuse, N. Y., has produced a number of inventions in this line. One of his latest is an apparatus for forming or shaping sheet metal, which is shown in the accompanying illustration.



DEWEY'S METHOD OF FORMING METALS BY ELECTRIC HEAT.

The machine is applicable to the forming of metal objects from sheets when heat is required to soften the metal, and particularly when successive and graduated pressings are necessary. In such cases, when ordinary presses are used, the metal becomes hardened after each pressure, and requires removal for successive heatings and annealings. In many classes of work the entire operation can be completed by Mr. Dewey's method without removing the sheet of metal, or the blank, from the press till the article is finished.

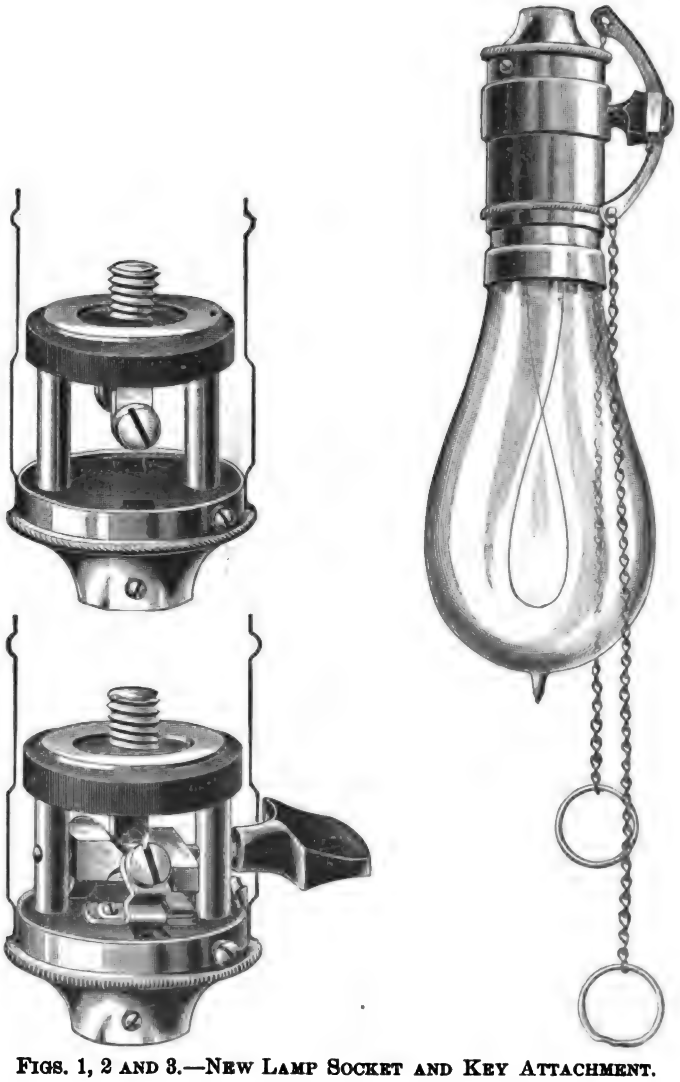
The method is here shown as applied to a hand press, but it is obviously equally applicable to machine presses. F F represent a screw press in two positions, with die and mold C and C'. A is a sheet of metal or a blank to be treated. When in operation, the yielding clamps, H and H', carried by the follower of the die C descend with it and press the sheet or blank firmly against terminals I and I' of the conductors *b* and *b'*. The current thus allowed to flow through the blank heats and softens it to the degree required to produce, under the proper pressure, an even distribution of the metal between the die and mold.

The clamps are either faced with non-conducting material, or the supporting bars E are insulated from the plunger at E'. The base of the press is insulated from the terminals. Mr. Dewey deems it advisable to face the die and mold with non-conducting material, or to make them entirely of such material. It will be seen that with suitable current regulation the sheet or blank operated upon may be kept at any desired temperature during the entire operation, or that the temperature may be varied or graduated for different stages of the work.

BROOKLYN, N. Y.—There has been filed in the county clerk's office, Kings County, the consent of 13,203 shares (out of a total of 15,000 shares) of the stock of the Edison Electric Illuminating Co., of Brooklyn, for the purpose of effecting a mortgage of the company's property for the sum of $2,000,000 to the Franklin Trust Co., Brooklyn.

NEW LAMP SOCKET AND SOCKET KEY ATTACHMENT.

We illustrate in the two accompanying engravings, Figs. 1 and 2, the new form of lamp socket now being manufactured by the Bryant Electric Company, of Bridgeport, Conn., a company which has become well known as the manufacturer of the Bryant switch. The cuts show a keyless socket, which requires no explanation, and the key-socket, which has been designed with especial reference to durability, simplicity of parts, good contact and quick make and break. The key is rectangular in section, and, as shown in the cut, the current is shut off, but when turned a quarter round comes into rubbing contact with the spring piece, forming one terminal, on the base of the socket. The action of the key is positive, the upright spring at the back pressing on the square surface preventing the key turning too far or not far enough. We illustrate also in Fig. 3 the Lewis attachment, manufactured by the same company, a very useful contrivance, where lamps are suspended too high to reach by hand conveniently. The attachment is the invention of Mr. Fred. Lewis, electrician of the New Haven Electric Company.



FIGS. 1, 2 AND 3.—NEW LAMP SOCKET AND KEY ATTACHMENT.

STARTING THE "SHORT" CARS IN ROCHESTER.

A very successful start was made on the lines of the Rochester Railway Co., a few days ago, of the Short electric system. The cars are very handsome and run extremely well. There will be 18 cars on the Lake Avenue line. The Sophia street line will be the next to be operated by electricity; then St. Paul street and then Main street.

THE LINEFF ELECTRIC TRAMWAY.[1]

BY GISBERT KAPP, M. I. E. E.

When we have to convey current to the car by means of a conductor, this conductor must run along the line either above or below ground. In the former case it may be a wire suspended along poles, or a rail resting on insulating supports close to the ground, or it may be formed by the tram-rails themselves. All these arrangements have been tried, but it is needless to say that they are inadmissible for urban and suburban lines in this country. With such lines the first condition must necessarily be to place the conductor underground. As usually carried out, this system involves the adoption of a slot in the road through which passes a slipper or contact-shoe attached to the car, and which establishes electrical connection between the conductor underground and the motor on the car. The system is, as experience shows, practically workable; though the slot, which must admit dirt and moisture into the underground channel and may to a certain extent inconvenience other traffic, is a disadvantage. This disadvantage may, perhaps, not be very great, considered from a purely technical point of view, but such as it is, it has to be taken into account. If we consider the question from the point of view which will naturally be taken by the local authorities and the public whom they represent, we shall come to the conclusion that the slot is a great disadvantage to the general traffic, and that its abolition is highly desirable. How to abolish the slot and yet retain electrical connection between the underground conductor and the motor on the car is the problem which has been solved in the system of electric tramway I am about to describe.

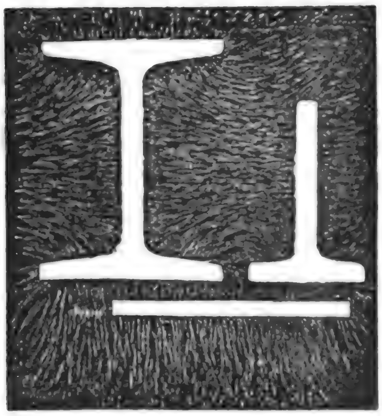


Fig. 1.—Magnetic Circuit, Lineff Railway System.

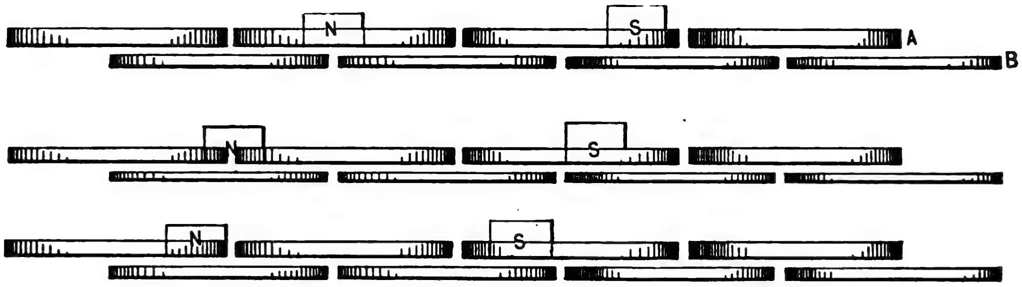
The conductor consists of bare copper strip or cable, and of iron strip. The latter is galvanized so as to protect it from rusting. It lies on the copper conductor, and both are enclosed in a sealed channel formed of asphalt. The copper conductor rests upon the bottom of a trough made of a succession of glazed tiles, and the cover to this trough is formed by the lower flanges of iron rails arranged in short sections so as to be insulated from each other. The head of one rail reaches up to the surface of the road; the head of the other is cut off, and this rail is, therefore, completely buried in the asphalt. The surface rail, which may be arranged alongside one of the ordinary tram rails, or in the centre of the track, is in electric and magnetic contact with an electro-magnet carried under the car. This magnet runs upon the surface rail on wheels, which form its north and south poles. The distance of the wheels is greater than the length of a section of insulated rail, so that successive sections become oppositely magnetized. This causes the iron strip immediately below the magnetized region to be attracted upwards and thus come into contact for a length of several feet with the under side of the two sectional rails. At the same time the iron strip to both sides of this region remains in contact with the copper conductor, and forms thus an electrical connecting link between the copper conductor and a few sections of insulated rail under the car. The current passes from the surface rail through the body of the electro-magnet (which is insulated from the body of the car) into the motor, and finally into the ordinary tram rails and earth in the usual manner. The electro-magnet is energized by a shunt current obtained from the main conductor, but to provide for the possibility of dropping the strip from some unforeseen cause there is placed on the electro-magnet a third thick wire coil, which can at all times be energized by two storage cells carried on the car, and thus the strip can be picked up and the main circuit again established if it should have been accidentally interrupted. I may, however, at once state that during some tests which I made on an experimental line of this kind, and which lasted over several days, there has been no need for the picking-up battery, as the current was never lost. I shall say a few words about the results of these tests presently; but before entering upon the practical results I would draw your attention to a question of both practical and theoretical importance—namely, the way in which Mr. Lineff makes use of magnetic lines of force to effect the attraction of the iron strip. It might, perhaps, be thought that the most direct, and therefore the best, way of utilizing the lines of force would be by one single line of sectional rail through which there would be longitudinal magnetic flux corresponding with the fore and aft position of the poles and attraction of the strip at every gap between two sections. Experiment has, however, shown that this apparently direct way is by no means the best way, and that far more satisfactory results can be obtained by arranging a more roundabout course for the lines of force. This is attained by the employment of the subsidiary or buried rail, the gaps in which do not exactly correspond with those in the main or surface rail, but are shifted forward by a certain amount. In consequence of this arrangement, the buried rail acts as a kind of magnetic bridge (*see* Fig. 1) to successive portions of the surface rail, and this action takes place in two ways, one direct and the other indirect. The direct way is longitudinal, and does not affect the strip at all. The indirect way is both longitudinal and transverse, the latter passing several times through the strip. The buried rail is a rather imperfect bridge to the lines of force traversing it longitudinally, because its magnetic resistance in that direction is great, but this rail forms a very efficient bridge for lines passing through it transversely, owing to its lower magnetic resistance in that direction, which includes the strip. This flow of magnetic force transversely is, therefore, that which effects the attraction of the strip, and may be represented as a series of magnetic stitches passing to and fro between the two sets of rails and the strip.

This action will be understood by reference to the diagrams Figs. 2 to 4, which represent the magnetic condition of the rails for three positions of the electro-magnet. A represents the surface rail, and B the buried rail. The energy provided to attract the strip is only 180 watts, or equivalent to that consumed by three glow lamps; and this I have found sufficient under all circumstances. Fig. 6 is a cross-section, Fig. 5 a plan, and Fig. 7 a longitudinal section of the line and electro-magnet.

The experiments to which I have referred were undertaken to see whether the whole system is practically workable. The first question which presented itself was whether the wave in the strip running along at the speed of the car was likely to induce subsidiary waves either in front or behind the car, whereby exposed sections of the surface rail might become charged and be a danger to ordinary traffic. To investigate this matter a pilot brush was fitted to the car at different distances

1. Abstract of a paper read before the British Association in Section G, Leeds, September, 1890.

from its centre, and connected with an electric bell. The pilot brush was so placed as to slide over the surface rail, and if on a charged section the bell would sound. It was found that the charged region was at all speeds considerably shorter than the length of an ordinary car. Contact tests were also made over the whole line at greater dis-



Figs. 2 to 4.—Diagrams of the magnetic condition of the rails for three positions of the Electro-magnet

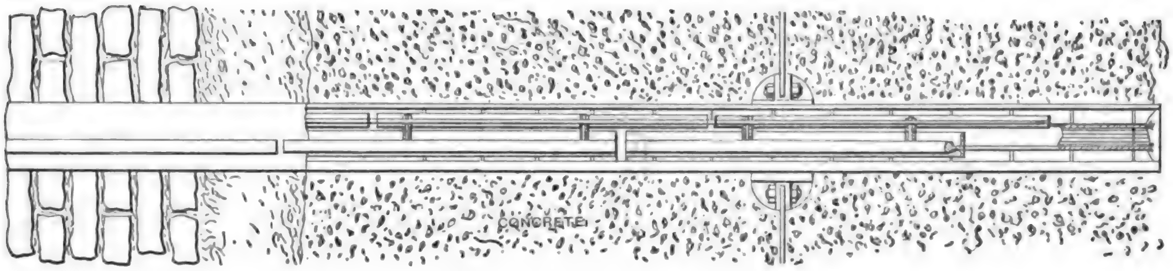


Fig. 5. Plan of Track.

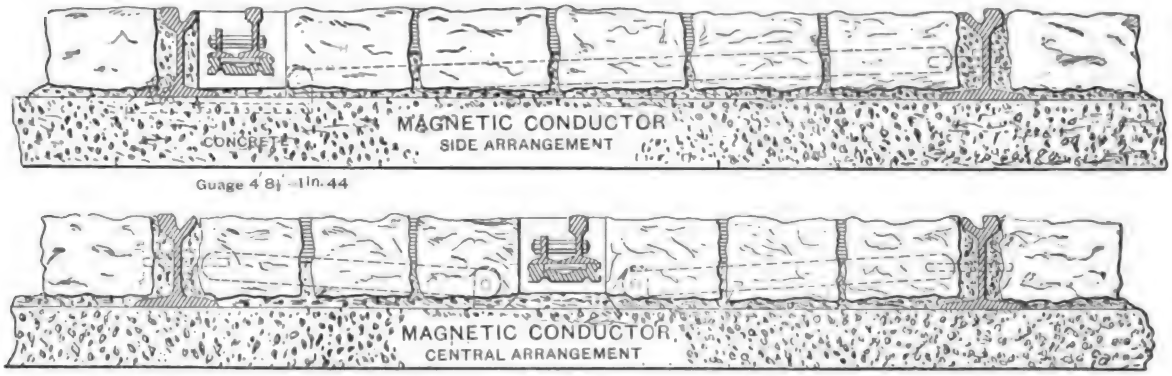


Fig. 6.—Cross-Section of Track

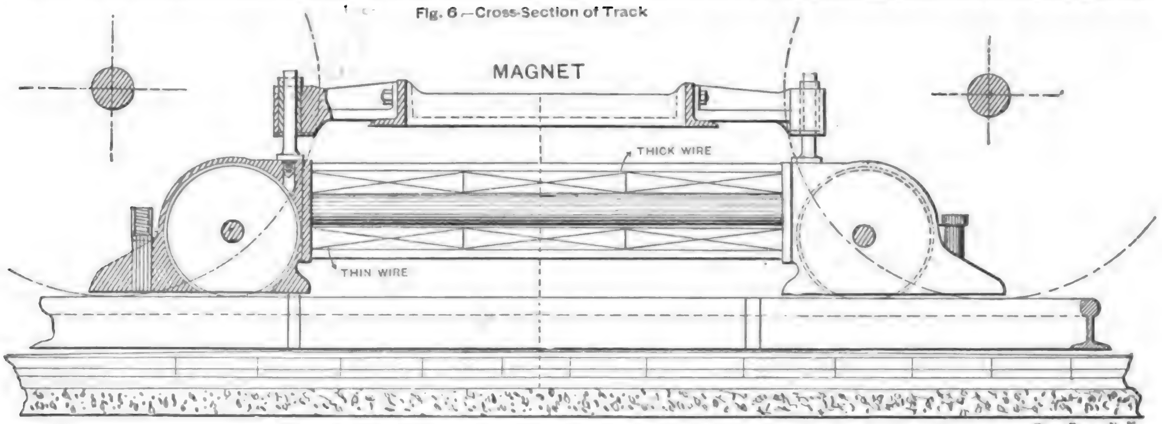


Fig. 7 Longitudinal Section of the Line and Electro magnet.

Elec., Engr., N. Y.

The Lineff Electric Railway Conduit System.

tances from the car than the pilot brush could reach, and in no case have I found an exposed section of rail charged. There was, further, the danger that with a dry and dirty line the collection of current might be accompanied by sparking, which would frighten horses; but this difficulty was overcome by fitting wire brushes to the pole-shoes of the electro-magnet.

An important point in all conductor systems of electric tramway is the energy spent in collecting the current. With the overhead wire system this is very small and practically inappreciable. With an underground system it is naturally larger. In the first system elaborated by Mr. Lineff, the flexible underground shoe with its trailing rope required from 20 to 48 lbs. for its propulsion. In the series system the "arrow" rubbing through the "spring jacks" must necessarily also require the application of considerable force; but I have no figures on this point. In the new Lineff system the electro magnet rolls on the surface rail, and the propelling energy is consequently small. I am informed by Mr. Lineff that he has succeeded in reducing it

to 210 watts with the magnet energized. The whole power spent in collection of current is therefore about half a horse power.

The insulation resistance of the conductor was tested both by the bridge method (48 Leclanché cells, Post Office pattern bridge, and mirror galvanometer), and by passing the leakage current through a voltmeter, and the two methods gave fairly accordant results. The highest reading I recorded by the voltmeter test, when the full pressure of 230 volts was on the conductor, was 5,400 ohms, and the lowest 3,550 ohms. From these figures it appears that the average insulation is 186 ohms per mile.

To ascertain the surface leakage I also applied the voltmeter test and found the following insulation resistances of three charged sections of magnetic rail. With the line clear and moist, 4,183 ohms; with the line very wet and covered with mud and horse droppings, 980 ohms. Taking 2,000 ohms as an average, the loss of power at 300 volts by surface leakage per car amounts to 45 watts.

The mechanical strength of the line was tested by running a steam roller over it in various directions, under which treatment the line suffered no damage whatever.

THE CIVILIAN ELECTRICIAN IN MODERN WAR.[1]

BY LIEUT. BRADLEY A. FISKE, U. S. N.

I BEG to propose for your consideration this evening a plan by which, in time of war, all the electrical resources of New York, both in supplies and in men, will become at once available for the defense of the country and the city.

It is well known to all here that electricity has come into use as one of the great factors in warfare, both on sea and shore, not as an adjunct merely, as for lighting ships and forts, but as a vital element in the handling of weapons in actual battle, and in the construction of new instruments which accomplish things heretofore impossible.

I desire to recall to your recollection a few of the most important uses to which electricity is now put in warfare, to indicate some of the probable paths of future development to show that it would be impossible for our regular navy and army to adequately handle the vast electrical work that would have to be instantly done in time of sudden war, and to suggest a plan for coming to their assistance.

The science of electrical engineering is now recognized as one of the most necessary of the practical sciences of the world. It stands out as distinct and defined as the science of medicine, or the science of astronomy. It enters into thousands of the departments of daily life, but into no other department is it used in so various and important ways as in warfare. This is so much the case that the prophecy is sometimes ventured that in the near future nations will fight by electricity. Though this, like all extreme statements, requires modification, yet the number of ways in which electricity has come to be applied within the last eight years, is calculated to inspire the liveliest anticipations as to the developments of the next eight years. No vessel pretending to modern equipment goes to sea without a complete electric plant for furnishing light. This light is so much more suited to ship life than any other light that we now wonder that we ever went to sea without it. The electric motor is coming into use for ventilating ships, and it is beginning to be used for training guns and the hoisting to the deck of shot and shell. The best and the most accurate results at target practice are attained when the guns are fired by electricity. Range finders give the gunner constant knowledge of what he must know, *i. e.*, the distance of the enemy. The best means of night signalling, and the one adopted in nearly every navy in the world, is by means of incandescent lights. The electrical search light is almost as much a feature of the equipment of a modern war ship as are her guns and her torpedoes. In the actual use of the Whitehead and Howell torpedoes electricity plays an important part. The telephone is now coming into use for ship work, and will unquestionably supplant the speaking tube, which is acknowledged in all navies to be unsatisfactory. In fact, we find all through modern war ships an increasing use of electricity. The reason is clear. The modern war ship is the most intricate, tremendous and powerful machine existing. In no other equal space can be found so many, so various, and so important kinds of apparatus. Everything must be done which will put her absolutely within the grasp of the captain. She must respond at once to his command, and her whole strength and power must be his, as though she were a part of him. Ensconced in his armored conning tower he must be the brain of the gigantic body. Electric wires must convey instant tidings to him from her innermost recesses, and electric wires flash back from him the inevitable command. In this way only can a modern ship, no matter how large, how strong, how heavily armored, or how swift, completely fulfill her mission and be a perfect fighting machine.

What is true of ships is equally true of forts. The power of ships' guns has so increased that it has become necessary to protect shore batteries by iron and steel instead of masonry, as in the days not long gone by, and, in addition, to use disappearing carriages wherever it can be done. Disappearing carriages, as is well known, are so arranged that the gun disappears below the parapet of the fort when the gun is fired, and remains out of sight and safe during the operation of loading, so that it is exposed only for a short time when it is raised to fire. Now, without the aid of electricity, a very considerable time would elapse, even after the gun was raised, before it could be fired; because the gun would have to be trained in the proper direction and be elevated to the proper degree for propelling its projectile over the distance between it and the enemy. To estimate this distance and make the proper adjustments would entail delay, and would be absolutely impossible if smoke obscured the target, as would be the case a great portion of the time. But electricity, acting through the medium of the position finder, gives the gunners continuous information of the distance and direction of the enemy, no matter how thick the smoke, so that they know exactly what to do before the gun is raised to fire.

Electricity, furthermore, gives the commanding officer complete control of all the different groups of guns and mortars in his fort. Noting the progress of the action from a station aloof from the smoke and noise, he can direct the concentration of as many batteries as he thinks best on one ship, or can disperse the fire as much as circumstances from time to time dictate.

For the handling of the monster apparatus used in forts, the guns, the carriages, the ammunition, electricity is rapidly coming to the front. Some power must be used, since the muscles of men are too weak. Hydraulic power has been used hitherto; but for many purposes electricity has the same advantages over hydraulics that have caused its unprecedented advance in the other departments of engineering throughout the world; while for repelling a night attack from ships, the search light has been found by repeated trials in the naval manoeuvres abroad to be simply indispensable to the land defense.

For military service in the field there is not an army in the civilized world that has not its military telegraph service. One great cause of the suddenness and completeness of the German victory in 1870, was the rapid mobilization of the Prussian army, and its appearance on the frontier ready for battle. Now the splendid efficiency of the telegraph service in the hands of the military authorities made this possible. Nothing is more important in warfare than despatch in moving the enormous bodies of men, of which modern armies are composed, with all their ammunition, equipments and numberless accessories. To move a quarter of a million men to the frontier in a single day, means a good deal; and to manœuvre so large a body of men with such precision and rapidity that no one division shall have to wait for any other division, simply cannot be done without electricity.

But the most immediate and important use of electricity in the defence of a coast is in the submarine mine or ground torpedo. Defending a harbor with submarine mines is simply carrying out with more or less elaboration a system by which a large number of water-tight tanks, each holding from 100 to 1,000 lbs. of gun cotton, or other explosive, are anchored in carefully defined positions, and connected by armored electric cables with protected operating rooms, in which are batteries, measuring instruments, etc. The more complete mines have usually floating above them automatic circuit-closers, in which two contact points are joined together by a passing ship, and thus afford a passage for the electric current to the fuse in the torpedo.

Now these mines are some of them exceedingly large and heavy, and the electrical apparatus, while simple to the mind of a trained electrician, yet must be made and adjusted with great care. The torpedoes as a system must be constructed, laid down, and connected to the operating rooms on shore by long and heavy armored cables. The operation of practically planting and connecting the necessary submarine mines for New York would be a stupendous undertaking. Kindly bear this in mind until I recur to it again.

We have now seen, after a rough survey of the subject, that electricity has already acquired an acknowledged position in the art of war, and that the uses to which it is put are not trivial ones. Electricity is not used in warfare as a convenience, nor is it a fad of theorists; it fires the guns, it discloses the stealthy approach of the torpedo boat at night, it directs the proper elevation of the guns; in fact, it does good, honest, practical work. But note this point also: in every one of these applications of electricity we have to pay, in one way, for what we get, by studying the ways in which electricity will work for us. We cannot expect electricity to work for us unless we treat her properly. We cannot handle electrical apparatus with carelessness and ignorance, and expect that it will work when we need it. In other words, we find in warfare, as in everything else, to which electricity is applied, that electricians are useful. This remark doubtless seems absurdly commonplace, but it is intended to suggest that, in war

1. A paper read before the N. Y. Electrical Society, Oct. 23, 1890.

time, electricians, even civilian electricians, may suddenly become very useful to the Government. A captain of a fine ship might lose an action from simply a lack of knowledge as to some electrical appliance on his part, or on the part of some subordinate; some small accident might break a circuit just at a critical juncture, which might prevent the communication of an order, the receiving of information or the firing of a torpedo, at a crisis; and yet the cause might be such, that a man with even a very slight knowledge could remedy the difficulty in a second by the mere pressure of his finger; but that pressure not being given, the action might be lost, and from that cause alone.

Let us now glance at some of the other uses of electricity to which it would probably be put in case of an attack upon New York. There can be no reasonable doubt that Lay torpedoes, Patrick torpedoes, Sims-Edison torpedoes, and Halpine-Savage torpedoes would come to the front at once. The enemy's fleet being daily expected off Sandy Hook, we should see the advocates of these systems, under authority of the general government, preparing stations at Coney Island, Sandy Hook, and elsewhere, for the launching of their dreadful missiles against his ironclads. The question of ballooning, both for observation and for the dropping of explosives on his decks, would be taken up at once, and the electrical world would be agitated anew over the question of balloon propulsion by electricity. Electric launches, ranged to carry torpedoes would be fitted out, to noiselessly steal out at night on their errands of destruction. Electric picket boats of smaller size perhaps, would scout the waters in pursuit of information or to convey despatches; electric submarine boats would spring into being by the dozen, and, filled with adventurous spirits, would seek the enemy, secure from detection below the surface of the sea, and carrying enough explosives to utterly destroy the proudest war ship of the world.

It will now be apparent, that in the case of a sudden war (and most wars are sudden), there will be an immense amount of work to be done in the electrical line alone. Could our regular Army and Navy do all this work in the time allowed? It is probably known to all here that our regular Army and Navy are simply a nucleus around which fighting forces could be formed. They are so small as regards both officers and men that they can barely carry on the work in time of peace, and would be wholly inadequate in time of war. We should not have enough battle ships, monitors, cruisers or torpedo boats; we should not have enough forts; we should not have enough sailors; we should not have enough infantry; we should not have enough artillery; we should not have enough electricians. Take the single matter of laying out and connecting up the submarine mines in New York harbor. This is an area covering many square miles, in parts of which the mines would be placed at frequent intervals; every mine being accurately secured in its designated place and connected by cable to the operating room, perhaps miles away. The mere labor of constructing, fitting and filling one mine, and afterwards taking it out into the harbor and lowering it into place, with all its connections, is no small task; and what can be said of the task of doing this with hundreds of submarine mines? Then the work of properly arranging the various cable connections, testing apparatus, firing apparatus, etc., necessary for the efficient action of the mines would follow. The Board on Ordnance and Fortifications have designed all the torpedo defences, but they will not be in practical operation, probably, for many years, and a war may come meanwhile. But it is certain that on the outbreak of any war an immense amount of this work would have to be immediately done, because we will never keep the submarine defenses of New York harbor on a war footing in time of peace.

The Navy Department would be even more hurried. We should certainly be called upon to commission a great many war ships, and to equip as commerce destroyers a great many merchant steamships; we should have to do all the things that we did on the outbreak of our last war, and in addition, we should be confronted with the necessity of fitting all kinds of fine apparatus, the necessity of fitting electrical appliances of all descriptions, besides securing gun-circles in place with mathematical precision, and of accomplishing all the manifold fine work that is required with the ordnance, navigation and engineering equipment of a war ship of the present day. And as to fitting on merchant ships, who is going to fit them out? This operation requires technical knowledge. Who has it? How many of the merchant steamship captains would be able to install and manage a battery of even Hotchkiss or Driggs-Schroeder guns, or could remedy an accident to either gun or ammunition?

It being apparent that the regular Army and Navy in event of a sudden war would be unable to handle all the electrical work that would certainly be thrown upon them, I will propose the formation of a corps of naval and military electricians to assist the regular Army and Navy in its work. Such a corps might exist in every principal seaport town on the coast; the principal one, of course, being the corps with headquarters in New York. Electricity being now a recognized factor in both naval and military war, and requiring expert electricians for its full development, there would seem to be just as much reason for an electrical corps in the National Guard of the State of New York as for infantry, artillery or cavalry. While the members of this corps would be men of technical knowledge, and while its sphere of usefulness in war would be because of that technical knowledge, it is obvious that the organization should be a military one, and that with some modifications it should be governed by the same principles as govern all military bodies. Being a military body under the Governor of the State, it could at once become available on the outbreak of war.

It would seem that this corps, like all other corps, should be composed of men of various ranks, subject to various duties. Many kinds of work would have to be done in war, and many kinds of men would be required to do them. On the outbreak of war, certain members would naturally elect duty in the Navy; others in the Army. The most obvious and immediate employment would doubtless be in the torpedo defence of the harbor, under the direction of the general commanding. And who can doubt the gratification which that general would feel, when suddenly ordered to defend New York harbor, on finding added to his list of subordinates a hundred or more capable electrical engineers, young, enterprising, accustomed to difficult electrical work, familiar not only with electricity in its technical features, but also acquainted with the electrical people of New York, with its factories, its places of business, and its methods of business. These men would become available in a day, and could be at once set to work in carrying out the details of the vast and complicated system. Their work need not be confined to that purely electrical in character, because every electrical engineer is, by training and of necessity, a mechanician, and every sort of apparatus would be readily understood by him, and a very slight training will make him master of it. Those members volunteering for naval work would be equally useful. The ordnance officer at the Navy Yard would suddenly find himself overwhelmed with a mass of work which he would be utterly unable to carry out without the assistance of some such sort as this. And for the reason that electrical engineers are of necessity mechanicians, a great deal of technical work could be entrusted to them; such as the arrangement and fitting of gun carriages, the storage of ammunition, the assembling of guns, etc. Their more immediate and obvious field, however, would be the installation and fitting of electric lights, motors, telegraphs, telephones, and other electrical appliances on board the vessels of war suddenly called into requisition. In the matter of fitting out merchant steamships their usefulness would be at once apparent. The number of regular officers would be found utterly out of proportion to the number of ships; the whole Navy would have to undergo an expansion. Only a very few regular officers could be assigned to each vessel; so that the majority of officers would have to be volunteer officers, as was the case in our Civil War. During the first part of the war the command of the different vessels would naturally be intrusted to regular officers leaving the other positions to be filled by volunteers. Now, as the commander of a ship is head of all the departments of a ship, he cannot give much personal attention to one special department. Therefore, the general arrangement and fitting out of all vessels, both regular war ships and merchant steamships, would have to be largely entrusted to volunteers in all that relates to the electric and ordnance equipments. Now, as the work of fitting out ships with electric and ordnance equipments calls for technical knowledge and experience of a high character, it is obvious that a corps of well-trained technical men, such as here suggested, would be more than useful, they would be necessary. A further field for employment of such a corps in time of war is suggested by the fact that the genius of our people tends towards constant invention and improvement of all sorts of machinery and apparatus, and our history has shown that every war has brought into being many inventions in weapons of defence and offence. Can it be doubted, then, that any future war would produce more such inventions? And in view of the great progress of electrical science since the last war, and in further view of the large number of electricians in New York, can it be doubted that many of these inventions would be electrical in character? Under the stimulus of a national peril, and with the resources of New York at command, it is certain that important and novel warlike applications of electricity would at once spring into being. And while our regular forces of both Army and Navy were employed on their specific duties, what more natural than that some new Ericsson should arise, and some new "Monitor," or other craft, startle the nations of the world? Therefore, besides the obvious uses to which such a corps as this might be placed, there are other uses, no less important, of inventing, constructing and using weapons of defence, the nature of which we cannot as yet even faintly conceive. And as few heroes of our late war go down to history with more glory than has Ericsson, so, perhaps, our next war may produce some electrician now unknown, whose fame will outlive the ages.

It would seem as if such a corps as this could be formed under existing laws, and that there would be no difficulty in enlisting members. The attractions of the Naval Reserve and of the National Guard seem sufficient to induce a large membership in the different regiments, and there is no reason why membership in an electric regiment should not be equally desirable and confer equal distinction. The qualifications for entrance as regards education and intelligence, would be greater than those for any other regi-

ment, corps or battalion. Its military and naval usefulness would be acknowledged, and its position in all respects would be one of dignity. The larger the membership, the better; provided, of course, that due care be observed in excluding undesirable persons. The whole electrical influence of New York and of the country would be at its back, with all its millions of dollars and its men of world-wide fame; and there is no reason why it should not acquire a national influence. The course of instruction could be readily carried out, embracing the naval and military applications of the purely technical science, with which the members are already familiar, instruction being given by regular Navy and Army officers detailed for the purpose. This instruction would naturally embrace the construction and care of apparatus. It being presupposed that there are different ranks in this corps, the system of instruction will naturally differ with the different ranks. With the higher ranks, it would naturally embrace the theory and practice of gunnery, navigation, including compasses, and seamanship. Steam engineering would probably not need to be taught, it being assumed that the members require very little instruction in that branch. For the lower ranks the scheme of instruction need not include much more than the handling and care of the different apparatus. On the outbreak of war the members volunteering for the different services could be subjected to certain examinations, and their rank determined by the proficiency exhibited. As to the details of organization, uniform, etc., these need not be entered into here, as they can obviously be settled at any future time. My only purpose now is to propose to you a plan for meeting an emergency, which may some day arise. I would hazard the suggestion that the corps or battalion should at first include about 250 members, and that it should be officered, uniformed and drilled in much the same ways as the other corps of the National Guard. I would even advocate a certain amount of infantry drill as a means of instilling the military idea. Occasional runs in the torpedo boat "Cushing," and frequent short trips out to sea for target practice in modern war ships, would be essential. There would be considerable work, but there would be many compensating social and other advantages. I have ventured with much diffidence to put forward this idea, but earnestly hope that you will think it worthy of earnest consideration. My only excuse for broaching it is that it has been in my mind for many years, that it has been commended by every man to whom I have spoken about it, and that I have been urged to bring it to the attention of the electricians of New York.

THE CENTRAL LIGHTING STATION AS AN INVESTMENT.[1]

BY B. E. SUNNY.

The central lighting station has been the subject of many lectures. It has been discussed from an electrical, mechanical and geographical standpoint, until there is not much left to say about it.

Everybody knows now what kind of apparatus to use; what steam plant to put in, and where he had better locate his central station. If he don't know, all that he need do is to tell the editor of his newspaper that he is thinking about embarking in the electric lighting business, with strict injunctions as to secrecy, and before he knows what has happened, he will be surrounded with a galaxy of dapper young electricians from the nearest big city, all brimming with wise suggestions and advice. If he escape them,—well, there is no use of discussing improbabilities.

Central stations, from an investor's standpoint, have not been discussed to any extent, however, and as I have had the opportunity of knowing the financial side of many of them, I may be able to make a few suggestions of interest.

While both the arc and incandescent light are young, they are old enough to give an account of themselves as money makers. They are not in their "infancy," as so many suggest, but are almost ten years old, and should stand or fall by the record that they have made during that period.

It may not be amiss to refer at this time, and in a brief way, to the introduction of these two forms of light to commercial and domestic use.

The arc lamp found a clear field, with practically no competition for out door and store lighting, and was immediately installed in all large cities, to permanently replace the gas and oil lamps that for so many years had quite indifferently performed the service. The additional cost at that time charged for arc lights as compared with gas was very great, but only in proportion, however, to the increased amount of light. Price was of secondary importance, as compared with the great demand for a means of making the stores and thoroughfares as bright by night as they were by day. The arc lamp became at once a popular and permanent adjunct in the service of the community, and, as years have come and gone, it has become more firmly intrenched, so that it is now indispensable. While there are a few small towns in the country that have escaped the vigilance or resisted the wiles of the electric light man, history fails to record a single instance where the arc lamp has been discarded, and the old methods of lighting substituted.

When we consider what the arc lamp is, it is obvious beyond all doubt that it is the best light that has ever been known. Brilliant, steady, noiseless; absolutely reliable, and at the same time cheap; it is permanent, and notwithstanding the inventive age in which we live, it will shine on for years into the future. There is no possible substitute for it as it is used now, and while we hear of the prospective betterment of this thing and that, how seldom we hear anybody suggest that there is soon to be a better light than the first-class arc lamp of to-day. The experimental stage has been passed, except as to minor details, and what we have now will stand the scrutiny, and defy the inventive genius of the next decade.

The incandescent light has had a hard fight for a position in the commercial and domestic world. Coming after the arc light, it has met the latter in competition for store lighting, and has felt the opposition of cheap gas and cheaper oil, in many instances difficult to overcome—especially in house lighting in a community where a small difference in price determined the choice of illuminants. Notwithstanding the fierce competition, the incandescent light has become a fixed factor, with a future before it that its most enthusiastic admirer is more than likely to underestimate. Safe, clean, beautiful, and above all, free from the injurious effects to health that are induced by the use of gas and oil as illuminants, there is only the incidental competition of gas and oil, that will be less and less as years go by, to retard it in its march to supremacy in the lighting world.

It seems an inflexible and unvarying rule of the universe that we shall suffer, to a greater or less extent, injury to persons and property through the imperfections of several great agencies in the service of the community. Every means by which a large mass of people are benefited, calls for tribute in the shape of annoyance, loss and injury, because of its failure to do that for which it is designed, uninterruptedly, reliably and perfectly. If we will go over the list of public corporations, and analyze the advantages and disadvantages growing out of the service they perform, we will find this true in every instance.

The water-works is a priceless boon—an indispensable public servant, but how often is the water, so generously distributed, so contaminated with impurities that it causes epidemics and frightful mortality. It is only a short time since that the water furnished in this city was the subject of bitter complaint by the press and the people—notwithstanding we have the greatest sheet of pure water in the world, by our side.

The gas works perform a service of equal importance with the water-works, but its imperfections are evidenced in the blackened walls and ceilings—the vitiated atmosphere, the suffocating of ignorant or careless users and the dangers of fire.

The sewerage system, so vitally necessary and important, frequently fails in its work of doing good always, and turns its attention to decimating the population.

The telegraph and telephone, the great time savers in this age where time is precious, vex us to the soul with their shortcomings, that seem to be beyond the power of man to prevent or cure.

The steam railway, performing the greatest public service, furnishes a column of disasters in the daily papers, and even the slow-going street car, with plenty of time to be perfect in the performance of its duty, is imperfect, in that it kills so much time in doing its work. If its sanguinary exploits ended in killing time alone, it would not be so bad, but it occasionally extends its field of operations to children and old ladies.

So it goes through the whole list, and we can contemplate with the greatest satisfaction the almost perfect service of the electric light, and its greater freedom from the annoyances and losses to those whom it serves than the agencies enumerated. True, it has contributed to a small extent, in comparison with its large work, to the fatalities and losses that the community must suffer for employing these public servants, but the circumstances in each case of injury or mortality have invariably been of an extraordinary character, and capable of permanent correction.

In connection with the success and permanency of the electric light, it can be said that no one recognizes the future of electric lighting more than our friends in the gas companies, more than 300 of whom are operating electric lights in connection with their gas works. The *Gas Directory* says that the gas companies are operating 32,000 arc lights and 140,000 incandescent. If it could be known in how many instances the individual owners of the gas property are also the owners of the electric light plant, it would be found that the number of electric lights in control of the gas companies is double the number shown.

In one year—from March, 1889, to 1890—the gas companies increased their ownership in electric lights to the extent of almost fifty per cent., indicating their faith in a most gratifying way in the earning power and permanency of the electric light.

If statistics showing the growth of the gas business during the past five years were available, I think it could be shown that the increase in gas consumption is nominal as compared with the growth in population, and that aside from the large cities, where

1. A paper read before the Chicago Electric Club Meeting, Monday, Oct. 20th, 1890.

the difficulty in stringing wires has retarded the electric light, the gas business has only changed with respect to the adoption of cheaper methods of manufacture, so as to compete with electricity. In the smaller cities, towns and villages, the electric light is available for every store and home, however remote, because of the inexpensive means that can be used for complete distribution.

The number of electric light companies operating in the United States is, according to recent reports, 1,483 against 968 gas plants. This great difference is owing to the large original outlay for a gas company as compared with an electric lighting plant. The former, with its heavy iron pipes buried in the earth, subject to heavy leakage and frequent expenditures for repairs, can only cover a limited territory, and yet calls for an investment five-fold greater than the electric plant. The electric plant, because of the great saving in the original investment, is invariably given the preference by investors, as is also the case with the electric railway as compared with the cable railway. Recent figures show 288 electric railways as against 44 cable railways in operation in the United States, while the latter has been in practical operation 16 years, and the electric railway half that time.

It is a self-evident fact, therefore, that the electric light is an absolutely permanent and growing investment; that it has taken its place, in the large cities, side by side with the great public corporations, contributing its quota to the general service and comfort.

By the excellent methods developed with such speed and skill the individual is served with light or power, regardless of quantity—little or much, and just as his convenience may dictate. It is under perfect control; is readily adaptable to the varying conditions of the demands, and on the whole, calls for no extraordinary skill to operate.

Above all, the price at which it can be produced, and that at which it can be sold, leave a margin of profit that ought to be satisfactory.

So far then, we find that the electric light is: First, a commercial success; second, that it is permanently installed in the service of the public; third, that its imperfections are less than those attached to any other public service.

I have gone over the condition of the business quite fully for the purpose of impressing you with the fact of its indisputable permanency. It is firmly lodged among the commercial enterprises, and has been for seven or more years. Now, the important thing to get at is, How does its record read from the investor's standpoint? Does it rank with the water-works, the gas works, the telegraph and the steam railway as a producer of dividends? Unquestionably it does. All who are familiar with the operations of lighting plants can bear testimony to the fact, notwithstanding the grave mistakes that have been made in planning for, and furnishing, the service, and which have materially lessened the net financial results. With the one possible exception of the telephone, the future of no business has been more greatly underestimated than the electric light. The telephone people—and I was with them for several years—blundered on the growth of the business with the greatest unanimity, and built everything too small. The electric light people did the same thing, and now the face of the earth is dotted with lighting properties, which were poorly planned, badly built, and indifferently managed. I have classed the lighting station with the water-works, the gas plant and other quasi public institutions, in the importance of the service rendered, and as to financial results; but in the matter of construction, I am sorry to say, that the average lighting station is inferior. Where do we ever find a pumping station in other than a neat, substantial brick building, rather than in a frame shell, covered with tar paper, or tin? True, there are many lighting stations expensively and durably constructed, but we can all point out a long list, located in cellars, basements, abandoned barns and cheap wooden structures, with the usual and customary trimmings of second-hand boilers, an engine too old for service in a saw-mill, and underwriters' wire. Of course such a plant is a cheap one, and it is within the means of almost any man to start one, but with what results? Excessive running expenses, and a succession of break-downs and repair bills, until the profits are eaten up, and there is nothing left for the owners but to abandon the property or sell out to some one who will reconstruct the plant on a proper basis.

This is one type of non-dividend paying lighting station. Another is the station that is well built, of brick or stone, with good steam plant and electrical apparatus, and starts off on its career with the applause of its projectors and patrons. It is a great success, and the patrons increase, until the fact is brought home to the owners that they have left no room for more boilers; more engines and electrical apparatus, and that to meet the additional wants, they must add to the building, and machinery; put up another stack and reinforce their pole line. Then begins the work that ends in the central station becoming an exhibition of engineering gymnastics. Engines of various makes are crowded in spaces too small for them; high speed and low speed; big boilers and little ones, until the station takes on so many peculiarities that a change of engineers is apt to shut it down, until the new man can unravel the awful mystery. The remarkable thing about such a station is that it generally pays good dividends, for the reason that every boiler, engine and dynamo is worked to its fullest capacity, and consequently under economical conditions. So long as the machinery stands the strain, the stockholders will have cause to rejoice, and it is at this juncture that they would be glad to have the demand for lights cease. In the nature of things, however, it is just at this point where the demand becomes particularly pressing, and the stockholders are confronted with the necessity of rebuilding in its entirety a station but two or three years old, too small for the reasonable demands made upon it. The rebuilding means the throwing away of the old station, in many instances; the selling off at a great sacrifice the smaller engines and boilers to make room for larger types, and the absolute loss of the labor and material in foundation setting, steam fittings, etc. The shares of stock representing the cost of the property abandoned continue, however, to be an obligation upon which dividends must be paid. Then during the transition period, while part of the work is being performed from the old station and part from the new, the increase in the operating expenses caused by two sets of men, and the disorganized condition of affairs, is very marked. It generally happens, too, that in their desire to make the new one a model station, the manager or superintendent devotes all of his time and attention to that work, and leaves the old station to the boys to run, with the usual results.

This is the type of station that changes from a good dividend payer to one that, for a time at least, quits paying, and then resumes; or if its capital is increased to take care of the rebuilding, it can continue its dividends during rebuilding, but on a smaller basis, because of the additional number of shares. There are but few central stations in the country that have not already, or must within a short time, go through such an experience.

The remedy is old, and naturally occurs to any one of moderate experience. It involves at the outset the selection of a larger lot, and the construction of a larger building than we can at the time see any possible use for. There seems to be no reasonable limit to the demands that may be made for facilities, so that reasonable methods of planning do not seem applicable. A larger lot and building does not call for an excessive increase in cost over what a smaller property would cost. In fact, the real estate and building are generally the smaller items in the original expenditure. If then, the boiler room, engine and dynamo rooms are planned for indefinite extension, according to the generous proportions of the building, not with reference to the growth of the next three or four years, but of the next 15 or 20 years, and the machinery selected be of a standard type and capable of duplication from year to year, the sacrificing of original investment would stop. There are some who calculate the depreciation on the machinery of a lighting station at 10 per cent. but many will agree that the estimate is excessive. There is no reason why boilers, engines and dynamos, with reasonable care, and the occasional renewal of parts subjected to heavy wear, should not last twenty years. I refer to standard apparatus, of course, and do not include experimental types, that are, or ought to be, thrown out after a brief use because of their inefficiency. Now if we start out right, with plenty of room, with standard machinery, and the territory that we have is good, the increase is sure to come, and can be cared for gradually, by the addition of a boiler, an engine, or a dynamo, without throwing away any part of the original investment until it is worn out. The whole secret of dividend-paying enterprises is in their ability to run reliably, every day and every year, without subjecting the machinery to excessive and abnormal demands, and in the avoidance of rebuilding or abandoning original investments. There is no lighting property to-day that cannot pay a regular dividend, and earn enough above it to add to the plant as the demand may require.

There is no fixed rule as to the dimensions of a station building that will serve the wants of its patrons, present and prospective. The growth of the business has heretofore been beyond the calculations of the most enthusiastic. The same statement is true with the telegraph and telephone. The Western Union officials are building additions on their already mammoth structure in New York that will increase the facilities four-fold. The great telephone building on Cortlandt street, designed four years ago to furnish all the service below Canal street, is inadequate to meet the demands. The telephone building in Chicago, but three years old, is badly crowded, while in the electric light branch of the service, the Arc Light Co. and the Edison Co. in Chicago have, after two years' operations, exhausted their facilities for extending in their present quarters. Rebuilding is in process, or under consideration at Omaha, Denver, Milwaukee and other cities in the West.

We cannot complain of this most prosperous condition of affairs. Rather do we congratulate ourselves on the increasing growth in population, which does not come to the large cities only, but to the small ones, and to the towns and villages all over the greatest Nation that the world ever knew.

With the increased number of people, comes the increased demand for everything, and what, more than light,—and the electric light at that! Is it not wise, therefore, to pattern after the most substantial and permanent institutions of the time, and build, not for the present and the immediate future, but for twenty-five or

more years ahead of us? What is now standard may be obsolete ten years hence, but at the same time, standards are slow to change, and with the economical and efficient boilers, engines and electrical apparatus of to-day, we are safe to embark in great and important investments, and leave the almost impossible task of improving on what we now have to take care of itself.

GENERAL INSTRUCTIONS FOR OVERHEAD LINE CONSTRUCTION FOR ELECTRIC RAILWAYS.

THE large amount of overhead railway work now in course of construction and the large number of roads which will undoubtedly be constructed in the future makes it desirable to have some clearly defined rules for the construction of overhead work, as well as that relating to the ground conductor. Our readers will therefore be interested in the admirable general instructions relating to this part of railway work, which have been issued by the Westinghouse Electric and Mfg. Co., and which if carried out faithfully cannot fail to result in a substantial and lasting conductor system, with the least possible annoyance to the public.

Franchises, Permits, Etc.—The owners of the railway must secure all necessary franchises and permits from public authorities, or private individuals, for properly carrying on the work of construction, including permission to set poles in the most advantageous positions, and to run guys where necessary. They shall also do all necessary removal or trimming of trees, and shall be responsible for all necessary removal of existing wires or poles or other impediments.

Contractors.—The contractors shall comply strictly with the local laws governing their work, and are responsible for all unlawful damage done by their employés in the progress of their work. They are required to do all the carting and storing of material, to furnish all horses, wagons, men and material for carrying on work.

Completion of Work.—Each branch of the work must be pushed rapidly to completion as taken up, all re-sodding, paving, etc., promptly done, and all debris and material removed. All break downs, or deteriorations of the work, which shall occur before the final completion and acceptance of the whole, shall be repaired and made good by the contractors at their own expense.

Inspection and Acceptance of Work.—The Electric Company may appoint an inspector, who shall have authority to decide and direct how every branch of the work shall be done and what

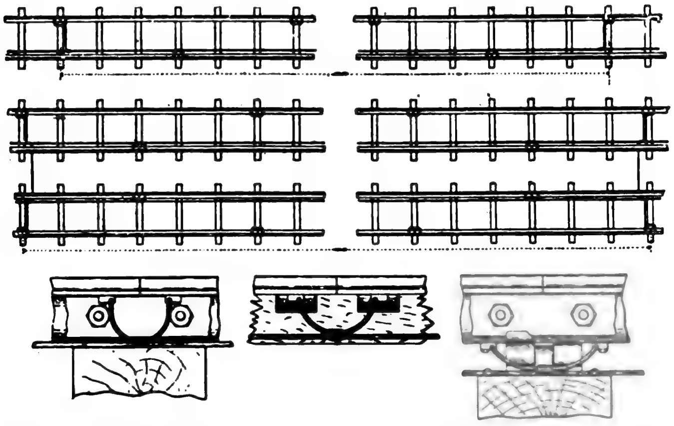


FIG. 1.—METHOD OF CONNECTING GROUND WIRE, SINGLE AND DOUBLE TRACK.

material shall be used. He may at any time order such changes and removals as he may see fit. If the inspector orders any work done or materials used which are not properly included in, or covered by, the contract, he shall give a written order to the contractors, specifying, as nearly as possible, the amount of labor and material involved. The inspector will give a written acceptance to the contractors when he considers their work properly completed.

TRACK AND GROUND CONNECTIONS.

On all roads where the size and material of the continuous ground wire are not particularly specified, No. 0 B. & S. galvanized iron wire shall be used. All joints in it shall be soldered. It shall be stretched taut, and secured to cross-ties or stringers with galvanized staples. It must be so deep in the ground that it cannot be reached by wheels, etc. It must be run close to one rail and connected to each rail bond it passes by a wrapped soldered joint. Every 150 feet a branch of No. 0 B. & S. wire shall be soldered to the continuous ground wire and to a rail bond on the other side of the track. Where there is a double track, there must be a cross wire every 150 feet, which is soldered to bonds or ground wire on all four lines of rail, and is the only cross connection required. It must be of No. 0 B. & S. (See Fig. 1.)

Between the ends of all consecutive rails, of whatever form, a rail bond, the Electric Company's standard pattern, shall be used. This bond is shown in Fig. 1. The holes in brass or copper block must be bored to fit rivet and wire, not punched. The end of wire must be put through block, and upset so that it cannot pull out, and the whole bond must be covered with half and half solder. The rivet must be Norway iron, $\frac{5}{8}$ inches in diameter, and of just sufficient length to pass through flange or web of rail and be riveted.

The best place for rivet holes in different kinds of rails depends to a great extent on paving and other conditions. The rivet must always pass through the rail, and be upset into a counter-sinking at the end of hole. No part of the bond must be exposed or

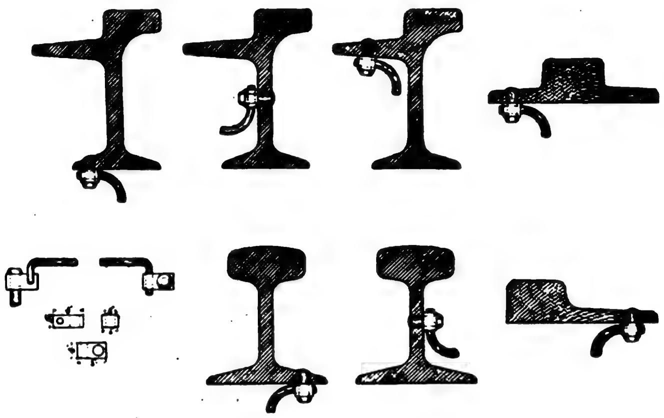


FIG. 2.—METHOD OF CONNECTING GROUND WIRE TO RAIL.

placed in such a manner that it can be touched by wheels or that the movements of the rail will tend to break the wire. The admissible positions for rail bond rivets in girder, T and tram rails are shown. (Fig. 2.) No rail bond may be less than 10 inches in length, and the bonds must be slack when in place, but as short as the conditions will permit. Where short pieces or castings, such as switches, frogs, or curve castings, occur in track, the pieces must be connected up in the same manner as consecutive rails, and each bond soldered to the continuous ground wire.

In steam railway crossings, each piece of rail must be connected to the continuous ground wire. Where a draw bridge is crossed, the rails on either side should be connected by a No. 0 B. & S. copper wire, weighted to the bottom of water, with such connection as is necessary for rails on draw.

Cables or wire leading from rails to dynamos must be soldered to continuous ground wires and bonds on all lines of rails, and must be connected to the positive terminal of dynamos. When ground feeders are run, they must be insulated in the same way as line feeders, but must, if possible, not be run on the same line of poles, and in no case must they be run on the same insulated pole tops.

POLES.

Wooden Poles.—Must be 30 feet long, and, for use on straight lines must not be less than 7 or more that 8 inches in diameter at top when finished, and they must not be less than 10 inches in diameter 5 feet from the butt. They must be of sound chestnut, cedar or Georgia pine, may be sawed or natural round, but in both cases must be dressed smooth and coned at top, cones having two coats of paint.

Poles for Corners.—At curves, and for the ends of line, or which in any way bear part of the pull of the trolley or feed wires, must be not less than 8 inches in diameter at top and not less than 12 inches at a point 5 feet from the butt. All poles must be straight and uniform and free from shakes, checks or large knots.

Iron or Steel Poles.—Of whatever form shall be of a strength and stiffness at least equal to the wooden poles specified. A pole made of three sections of extra heavy pipe, top section 3-inch pipe 5 feet long; middle section 4-inch pipe 6 feet long, and bottom 5-inch pipe 16 feet long (these lengths do not include the lap in joints), is sufficient for light work. All joints must be made perfectly rigid and as strong as the adjoining pipe, with proper provisions against telescoping.

All iron poles must have a thoroughly insulated iron top, to which wires are secured. This should be mounted in a hard wood plug in pole top, boiled in paraffine. The top must protect the plug entirely from water; it must have a deep petticoat extending at least 1 inch below pole top, and standing at least 1

inch clear of it on all sides. This top must be fitted with fixtures for securing span wires and insulators for feed wires, etc.

For Curves.—Angles of feed wire, and ends of line, etc., extra strong poles must be used. There is nothing in the work of building a line so essential to its durability and good working as is the perfect rigidity of corner poles. The top section of curve poles should in no case be less than 5-inch extra heavy pipe, and of course special insulated tops must be provided for them. Corner poles must be fitted with strong eye-bolts below the wooden plug for fastening guys.

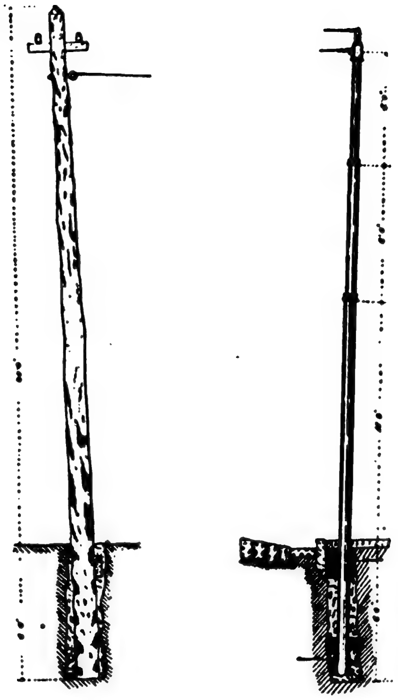


FIG. 3.—METHOD OF PLANTING WOOD POLE AND IRON POLE.

Pole Setting.—All poles on straight line work shall be set 6 feet in the ground. Large stones shall be tamped hard against butt of pole on side away from rails. Where practicable, pole should bear at surface of ground against curb stone, or have the space between it and curb stone filled by another stone or stones. Where there is no curb stone, a timber not less than 4x8 inches and 3 feet long shall be laid against the rail side of pole, 6 inches below the surface of the ground. A large stone, at least 2 feet long and 1 foot wide, should be used in place of timber when practicable. All poles shall be tamped solidly. (Fig. 3.)

In setting iron poles, good cement concrete must be used. The quality of the concrete should in all cases be good at the top and bottom of holes, and large stones may be used at these points to advantage. The hole in which an iron pole is set should be at least 20 inches in diameter, and filled with concrete, which should be given ample time to set before any strain is put on it. Poles of wood or iron for straight line work should have about 3 per cent. of rake away from street. (Fig. 3.) Wherever possible, the line of the tops of poles should be at a uniform height from rails, and the ground around poles should be graded to give the pole the proper depth of setting.

Poles which support part of the strain of curves or bends of trolley or feed wires must, in all cases where it is possible, be thoroughly head guyed. When this can be properly done, no extra precautions need be taken in setting, and poles should be set nearly vertical. The same applies to poles which support ends of lines.

Guy stubs must be anchored 5 feet in ground, and their tops must be 6 feet above ground; the stubs must be at least 8 inches in diameter, and must rake well towards pole top or point directly towards it. Guys must make no metallic contact with insulated pole tops or with any other wires which lead from the pole. Guys must be made of twisted (doubled) No. 6 galvanized wire or something equally strong and durable. (Fig. 4.) When guys cannot be used on the poles above mentioned, they must be set 7 feet deep in a hole 30 inches in diameter and built in solid with stone and concrete. Poles shall not be more than 125 feet apart, except where a greater distance is unavoidable.

In all cases where the character of the soil or the nature of the strains make the ordinary method of setting poles inadequate, precautions must be taken to make poles sufficiently firm, and whenever poles yield under the strain put upon them, the Electric Company's inspector may have them re-set at the contractor's expense. This may also be done when poles are displaced by undue strains imposed by contractors in building line, etc.

When the poles are not set by contractors who put up the wires, the latter must assume responsibility for the rigidity of curve and terminal poles, and their work can in no case be made acceptable unless these poles are thoroughly strong and firm or properly guyed.

FIXTURES.

All insulator pins and pin brackets shall be of the best oak or locust. Pin brackets shall be secured to pole with one 5-inch and one 7-inch lag screw.

Cross Arms.—Shall be of the best pine, 3¾x4¼ inches, painted with two coats Indian red. They must be secured in perfectly fitted gains with two 7-inch lag screws. Insulators must be extra heavy, such as are made for the largest sizes of wire. Where sharp turns are made with heavy wires, two or four cross arms must be used, and where necessary, iron pins and large paraffined wooden insulators may be used.

WIRE CONSTRUCTION.

Span Wires.—Are to be of stranded wire, $\frac{5}{16}$ inches in diameter made of 7 wires without a core. They must be secured to eye-bolts which pass through pole and have a nut on the opposite side. These bolts to be of ⅝-inch galvanized iron. With iron pole a suitable eye must be provided for span wire. The height of eye-bolts from the rail must be uniform on streets of equal width, and must be such as to hold the trolley wire at a height of 19 feet from the ground. A span wire must be allowed to sag about 3 per cent. of its length. When first put up, span wires must be left with one temporary connection, and must be carefully pulled up to uniform angle after trolley wire is run. They must in no case be connected so that slack cannot be readily taken in.

Span wires proper are only to be used where the line is perfectly straight. Where there is any lateral strain on trolley wire, double pull-off brackets must be used, with wires of the same material as span wires, leading to opposite sides of street.

Trolley Wire.—Must be put up in as long lengths as can conveniently be handled. The ends must be secured to a long V made of double $\frac{5}{16}$ stranded wire and led from securely guyed poles; it must be connected to this V by an insulator of suitable strength. Trolley wire must be drawn to a moderate tension only, allowing about 18 inches of sag in 125 feet. In hot weather it should be drawn slightly tighter. It must be run off large reels, on which it is carefully wound; it must not be bent, kinked or scratched. The practice of temporarily securing long lengths of trolley wire and allowing by guess-work for each curve is not approved, as it is sure to cause inequalities of tension in line or improper position of curves. Curves should either be completed as they are reached by the trolley wire, or should be built successively after the wire is up, an ample amount of slack being provided and carried ahead as the curves are completed, the line

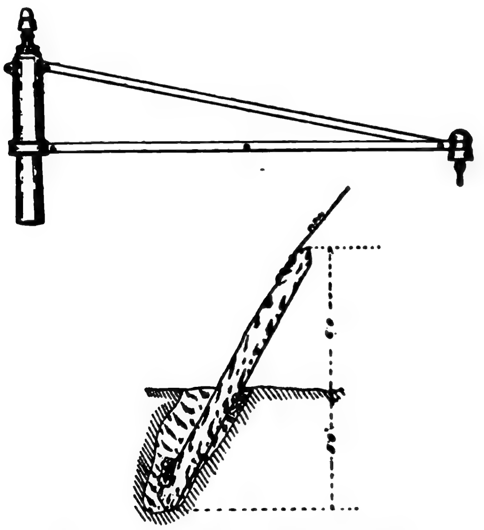


FIG. 4.—GUY STUB AND OUTRIGGER.

being permanently drawn to the proper tension and bridled as each is reached.

The hanging line insulators which support the trolley wire shall be clamped on (not soldered) after the line is accurately in place and all curves completed.

Joints in trolley wire shall be made in suitable brass tubes with tapered sides; they must be soldered by pouring, must be wiped smooth and must bear a strain equal to the strength of the wire itself. Joints shall not occur in, or near, curves.

Construction of Curves.—The positions of poles near curves should be carefully selected, and the poles must be permanently guyed, or otherwise properly strengthened, before work of running trolley wire begins. At the beginning and end of each curve the line must be bridled to the corner pole and one on the opposite side of the street. The fixtures for these bridles serve as the first and last pull-off brackets. They must be carefully swetted to the wire. Not more than five pull-off brackets shall be used between these bridle fixtures on a 90 per cent. curve, except where the curve is very long.

Pull-off Brackets.—The pull-off brackets shall be at equal intervals and soldered to the wire. They must be so placed that the trolley is exactly in line with the wire as it passes them. To accomplish this the bracket must be more or less inside of line vertically over the centre of the track, the height of the wire and the radius of the curve determining the position.

Pull-off wires shall be of the same material specified for span wires. They may be secured either directly to eye-bolt on pole or to a stout galvanized iron ring at a suitable distance from pole. On double curves, etc., insulators shall be used only on wires which run to poles. Where short wires are used to connect pull-off brackets (for instance, those which lead to the brackets on the inner curve) no insulators shall be used.

The weight of curves must be supported by double pull-off brackets, with wires leading to opposite side of street. Fig. 5 shows a sample curve. On all curve construction the greatest neatness and strength will be insisted on; the minimum possible number of wires and insulators must be used; the angling of wires must be advantageous; every wire must be made to serve as many purposes as possible.

Switches, crossings, circuit breakers, lightning arresters, etc., etc., shall be used when and in the manner specially directed.

All Material and Fixtures.—For line work shall be of the form supplied or specified by the Electric Company. All joints and connections in insulated wires shall be covered with three layers of the best weather-proof tape. All ungalvanized iron work and wooden insulators shall be thoroughly and neatly painted with P. & B. paint. Joints in feed wire must be of a neat, strong and approved form, thoroughly soldered. No telegraph joints will be allowed in wires larger than No. 0 B. & S.

Feed Wires.—These must be put up to gauge specified and must be 97 per cent. of the conductivity of pure copper. They must be put up without kinks or injury to the insulation and in lengths of not less than 500 feet. Feed wires must be led into the power station through suitable rubber or porcelain insulators. Every connection to the trolley wire must be made through one of the span wires, which must be fitted with an insulator at each end, and connected to the feed wire by an insulated jumper of No. 6 B. & S. wire, soldered to both. Connection to the trolley wire must be made by an insulated hanger, similar in appearance to the regular insulators. These span feed wires must be of the same material as regular span wires, but covered with the best weather-proof insulation. Where feed wires have to be led under water, the best armored cables must be used and suitable terminal fixtures.

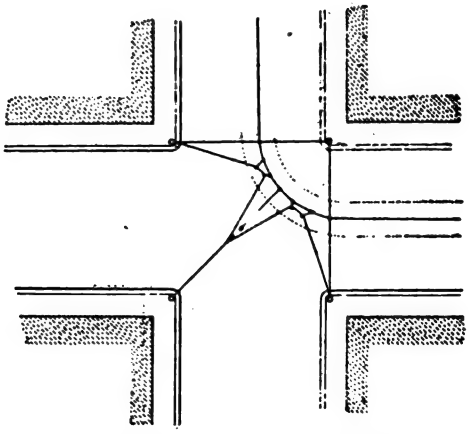


Fig. 5.—Method of Constructing Overhead Curve.

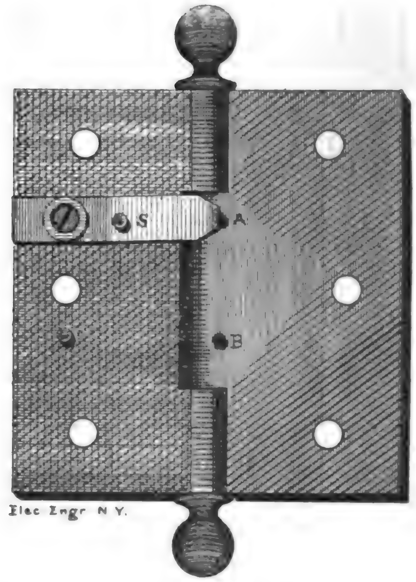
Guard Wires.—Wherever there is great danger of crosses with telephone, telegraph or other wires, through their falling on the trolley wire, guard wires must be used. They must be of No. 8 B. & S. galvanized iron wire, and must be hung to span wire of the same material as the ordinary span wires. Guard wire must be 18 inches or more above the trolley wire. They must be insulated from the span wires, and the span wires must be insulated from the pole tops. Porcelain insulators may be used, but must have no sharp edges.

On single track work, guard wires must be four feet apart, with the trolley wire midway between them. On double track work, three wires will be used, one two feet outside of each trolley wire and one in the centre. Guard wires should not be used except where the need for them is very positive and where their construction can be made simple and effective. A complication of guard wires will always be a source of trouble.

Outriggers.—When the trolley wire is hung to outriggers instead of span wires, the insulators must be so constructed that they will bear the lateral strain from the wire where the line is not straight. The outrigger arm must be insulated from the pole when the latter is of iron. (See Fig. 4.)

BLEAKLEY'S BURGLAR ALARM DOOR HINGE.

The accompanying engraving illustrates a very simple hinge designed by Mr. Wm. M. Bleakley, of Verplanck, N. Y., with the object of affording a ready means of connecting doors with burglar alarm systems. As these systems are operated, according to the requirements, both on the open and closed circuit plans, the inventor has so designed the hinge that it can readily be applied to both. As will be seen, the hinge has mounted upon it a spring which is insulated from the metal of the hinge, and has a terminal, S, to which one side of the circuit is attached. On the other leaf of the hinge there is fixed a small knob, A, of hard rubber, so placed that, when the door is closed the knob pushes the end of the spring out of contact with the other leaf, and thus breaks the circuit. Now, the slightest movement made to open the door moves the knob, A, from under the spring, allows it to come down on the opposite leaf and closes the circuit, which rings the alarm.



Bleakley's Burglar Alarm Door Hinge.

Where the closed circuit method is employed the spring is removed to the lower part of the hinge and then comes in contact with the metal knob, B, so as to close the circuit when the door is shut. Upon opening the door the spring falls away from the metal knob, but, without touching the leaf, remains with its end free, thus leaving the circuit open.

The device is evidently very simple and meets both kinds of service.

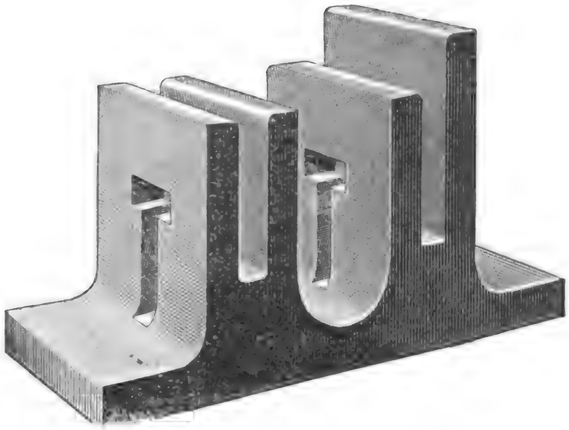
PROPOSED HYDRO-ELECTRIC POWER STATION AT LYONS.

In Lyons the number of domestic manufactures is very great, so that it offers a promising field for the distribution of power by electricity. A project to make use of the water power of the Rhone is now being inquired into by the Government. The promoters of the scheme have constituted themselves into a syndicate (Syndicat Lyonnais des forces motrices du Rhone), and they propose to spend nearly three quarters of a million sterling in digging a navigable canal 18.6 kilometers long, and establishing a hydro-electric generating station, having an output of 12,800 h. p. It is estimated that a charge of about 125fr. per h. p. year will yield a fair return on the capital outlay. Hitherto considerations connected with the navigation of the river have prevented any utilization on a large scale of the Rhone waters; but the present scheme overcomes that objection by the construction of the navigable canal.

THE GIBBON DUPLEX RAILWAY TRACK.

THE appreciation of electricity as the leading power for street railway propulsion, has led to belief in more than one quarter that a radical change will soon be demanded for the improvement in track construction. The essentials deemed necessary for this improvement, not only for electrical propulsion but for any other power, are :—

1. All material used in track construction should be of an



PERSPECTIVE VIEW OF SINGLE CHAIR.

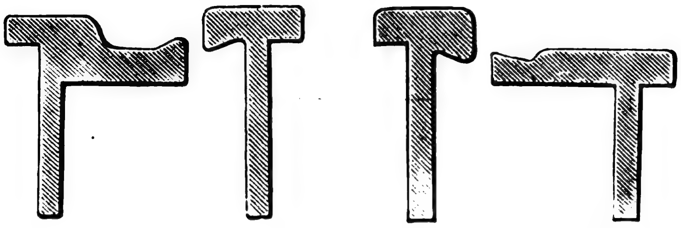
imperishable character. 2. Its design should be simple, and its parts few, and easy of access, so that only the part worn may be renewed with rapidity and with little disturbance to the street pavement. 3. It should possess lateral as well as vertical strength, and be able, under any circumstance, to keep true alignment, grade and gauge. 4. It should have absolute permanent contact of metal throughout the whole length of line, and under every and all circumstances be free from any depressions at the connection of rails, in order that the load which it has to carry may be transmitted uniformly, steadily and rapidly, with the least possible oscillation. 5. It should be of the stringer form, to act as a wall for the support of the paving.

A railway track composed solely of steel and iron, evidently insures the durability of character, and longer life and better service, than a structure composed of steel and timber. Such a structure would possess the strength laterally, as well as vertically, so that neither the lateral thrusts from the heaviest trucks could disturb its alignment, or the heaviest cars, running on it, cause permanent depression at the joint.

A track designed to meet all these requirements was exhibited by Mr. Gibbon, chief engineer of the Gibbon Duplex Railway Track Co., of this city, and received very marked attention at the late Buffalo Street Railway Convention.

The accompanying illustrations show the system to consist essentially of four parts, namely, the rail proper, the chairs, the tie-rods and automatic lock wedge. The rail is made in two separate sections, called the "head" section, and the "flange" section. The head section has a girder directly beneath the centre of the bearing surface. The flange section presents a bearing surface similar to the flange of a side bearing rail, and has a girder directly beneath the centre of the bearing surface. The two sections combined form a double girder side bearing rail, the girders acting as a wall for the support of the paving.

The chairs are of two kinds. The joint chair and the inter-



GROOVED RAIL. SIDE BEARING RAIL.

mediate chair; the joint chair being larger and having two T-shaped slots and the intermediate chair only one. Both, however, have a large area of bed plate surface.

The T-shaped slots are to receive the tie-rods and wedge keys, and it will be noticed that the wedges not only lock the rails and chairs, but lock themselves in place, so that there is no danger of their being jolted out of place by the action of the cars.

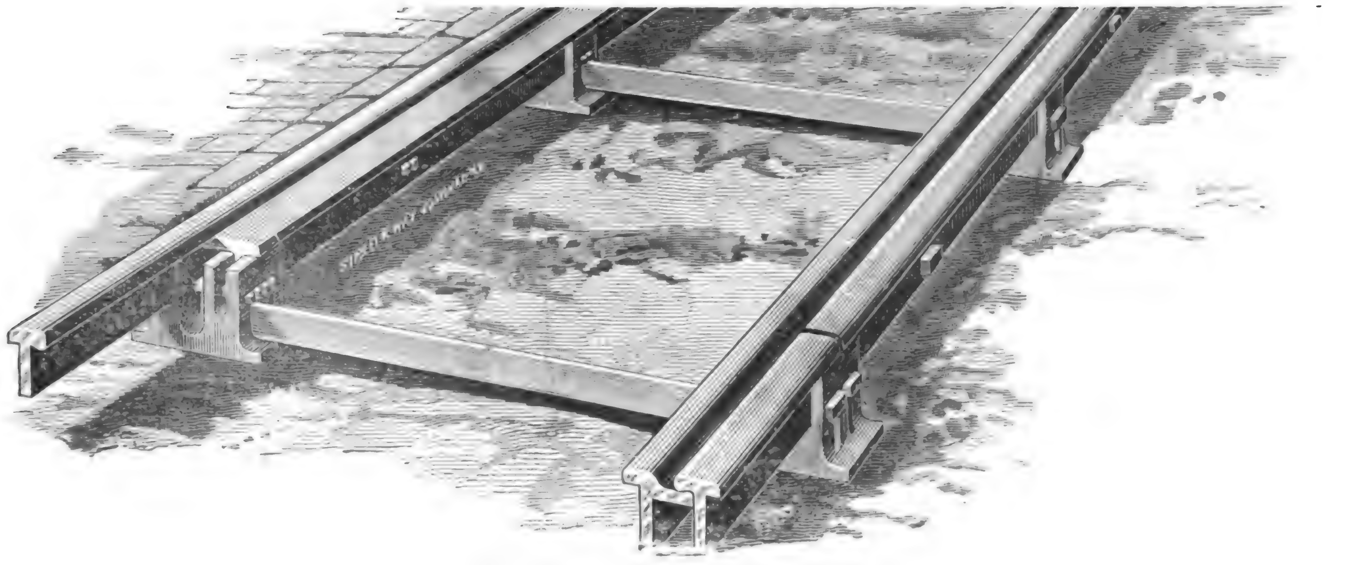
The tie-rods are ordinary strips of iron or steel about 2 inches in width and from ⅜ inch to ½ inch in thickness, which are slotted to the guage required; these slots receive the lower edges of the girders of the "head" and "flange" rails.

In laying track, the chairs are placed in position on their prepared foundation of concrete or stone, and the tie-rods are slipped through the slots in the chairs so that the slots in the tie-rods correspond to the slots in the chairs. A pair of joint chairs, with the tie rods, are placed every 15 feet, and the intermediate chairs and tie-rods every 5 feet, thus tieing and chairing every five feet of track.

After placing the chairs and tie-rods in position, a wooden template of the girder of each section of the rail is placed longitudinally in the grooves in the chairs, which operation spaces the chairs and gives alignment. The trenches are then filled with sand and firmly tamped; this being done, the inner template is removed, and the girder of the flange rail dropped in place. The outer template is then removed, and the girder of the "head" rail dropped in place, but in such a manner as to break joints, the

AUTOMATIC LOCKING WEDGE KEY.

TIE BAR.



THE GIBBON DUPLEX RAILWAY TRACK.

ends of the "flange" rails being covered by the solid head rail, and the ends of the head rails supported by the solid flange rail, thus making a compound rail.

The completed rail forms a box filled with sand, presenting a 5" x 6" beam for vertical and lateral stiffness.

After the two sections of rails are placed in proper position, the automatic lock wedge keys are driven in place.

The keys are so made that the narrow edge binds on the chairs only, the slots of the rail being longer than the width of the wedge. The broad edges bind on the rail; by this means, the rail is allowed to expand and contract by sliding on the broad surface of the wedges, thus giving continuous contact of metal at the joint with power to expand or contract in the space allowed by the engineer.

The rail being rolled in two parts, it is obvious that either can be renewed without discarding the other, thus insuring maximum wear with minimum waste of rail and with little disturbance to the pavement.

FLOOD'S CAR STARTER FOR GRADES.

The heavy currents usually required to start a car from a dead standstill to its normal speed are sufficiently marked even on a level track, but become a source of much annoyance and not infrequently of harmful strain upon the machinery, as in this case the car is obliged frequently to start with the brakes on, this latter condition being necessitated in order to prevent the car from running backwards down hill.

To avoid these necessarily excessive strains, and, indeed, to assist the motor in its work of starting the car, Mr. P. Flood, of Albany, has designed a simple car starter.

FIG. 1.—THE FLOOD CAR STARTER.

This starter consists of a dog or engaging bar, the end of which is pointed to facilitate its engagement in the pavement or ground between the tracks, and is pivoted to a sliding bar running under the rollers which reduces the friction to a minimum. On the sliding bar is a spring which compresses with the load, and so that the compression will be proportionate to the load. Thus, as soon as the car starts forward the resilient force of the springs aids in propelling the car in its forward movement.

The accompanying engraving, Fig. 1, shows a view of the car with the starter attached, and Fig. 2 shows a view of the details of the apparatus, which are exceedingly simple. The dog serves as a check or stop to prevent the car from running backward, and could, and is meant to, be used should the brake fail. It is operated by the driver by raising and lowering a foot lever attached to the dog by cables running on pulleys. When he wishes to stop on a hill, he drops the dog, applies the brake, and when the car stops, releases it, allowing the weight of the car to rest on the dog. The great advantage over the old way in starting with the brake on, and what a saving of power there is achieved, will be readily apparent.

These starters are in use on all the thirty-two cars of the Albany Railway Company, Albany, N. Y., and have proved so satisfactory that no car is allowed on the road unless equipped with one.

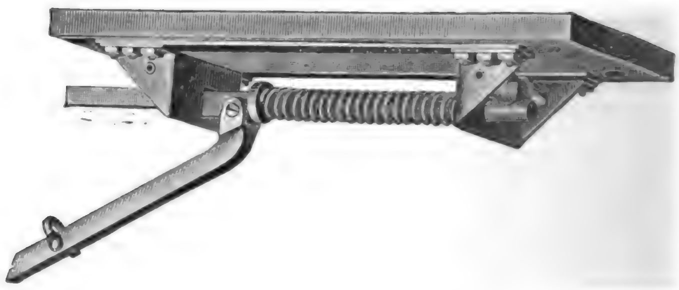


FIG. 2.—FLOOD'S CAR STARTER.

The grades on this road are amongst the steepest in the country, but with this starter the cars are able to stop when and where they please. They are simple and easily kept in order, and do not interfere with the wiring or motor mechanism of electric cars, and can be placed on any style of car or truck. If needed they can be attached to both ends of the truck.

PRIVATE TELEPHONE LINES IN GERMANY.

The German postoffice until recently held the sole right of erecting or licensing private telephone installations, thus practically prohibiting the development of telephony in Germany. On July 10 the Royal High Court of Justice decided, however, that the government had no right to restrain or prohibit the plaintiff erecting and maintaining private telephone installations. The decision was an important one, as it released private enterprise.

NEW ELECTRIC ROAD AT RICHMOND, VA.

Newspapers from Richmond report the successful starting up of the new road of the South Side Land and Improvement Company, equipped by the Equitable Electric Construction Company, of Philadelphia, whose noiseless gearing gives great satisfaction. The road starts with five cars of the vestibule pattern.

LITERATURE.

Incandescent Electric Lighting. By L. H. Latimer, C. J. Field and John W. Howell. Illus. Paper. 140 pages. Van Nostrand Science Series. D. Van Nostrand Co. New York, 1890. 50 cents.

THIS admirable addition to an admirable series comprises three papers. The first is "A Practical Description of the Edison System," by W. Latimer. It enters into a variety of details, and touches upon all points of interest with intelligence and success. The generator, lamp, meter, and other parts of the system are discussed in such a manner as to be useful even to those who do not follow electrical engineering as a profession. The next paper, that by Mr. Field, deals with "The Design and Operation of Incandescent Stations." It is based on Mr. Field's experience, especially that gained in the fine station built and equipped by him in Brooklyn. The third paper by Mr. Howell treats of "The Maximum Efficiency of Incandescent Lamps." It was read some time ago before the American Institute of Electrical Engineers, and now appears as a welcome permanent addition to the meagre literature of the glow lamp. It shows just what are the true conditions to aim at in running a plant, and formulates the law that the total cost is always a minimum when the cost of lamps is about 14.5 or 15 per cent. of the total cost of operation. Altogether the book is one we can heartily recommend.

Generation, Distribution and Measurement of Electric Current for Light and Power. By A. J. Lawson. M. Can. Soc. C. E. A paper read before the Canadian Society of Civil Engineers. Montreal, 1890. Printed for the Society by John Lovell & Son.

THIS is an extremely interesting review of the subject suggested by the title, and embraces, moreover, a valuable historical sketch of the development of electric light and power in the Dominion. Mr. Lawson has collated his facts with great industry and handled them with no less intelligence, and his paper is, so far as we know, the only treatise of its kind thus far published in Canada.

It is not necessary for us to go over the technical matter that forms a large part of the pamphlet, since it is an old story to our readers, but we may note the fullness of data as to many of the details, and approve the practical advice that Mr. Lawson gives in a kind of running comment. He is also to be praised for supplementing the text with so many excellent illustrations. Speaking of the work done in Canada, Mr. Lawson says that ten years ago there was not a single electric lighting plant in Canada. The first installations were of the Brush system, a pioneer evidently in the Dominion in arc work, as well as everywhere else. In 1882, two Maxim incandescent plants were installed in Montreal. In one instance, earth return was used, and in the other mere single cotton-wound magnet wire was used. The same year a contract was closed for a large Edison installation at Cornwall. At the present time—says Mr. Lawson in his paper, which is now a few months old—there are 13,530 arc lights in the Dominion and about 70,765 incandescents. Mr. Lawson states that 4,520 h. p. of water powers is used in lighting and motor work. He hazards the opinion that within the next ten years, three-fourths of the incandescent lighting in Canada will be done by the alternating system, while a large proportion of the mills and factories within five and ten miles of water power will be operated by electric motors by means of that natural agency.

ELECTRIC RAILWAY WORK AT OTTAWA, CAN.

A great sensation has been caused in Ottawa by the award to Ahearn & Soper of the electric railway contract by the city aldermen instead of to Howland & Gemmill. The *Free Press* of October 21 says: "The offer of Messrs. Ahearn & Soper to construct the proposed electric street railway has created a sensation, and the matter was the topic of general conversation to-day. Messrs. Ahearn & Soper began the electrical business in Ottawa in 1883. Reference to Dun, Wiman & Co., shows that the firm is to-day rated at from $150,000 to $200,000, and while the business they have done has largely been in contracts outside of Ottawa, they have built up an electric light business here that has been characterized as the most successful in Canada. Their principal contracts have been with the C. P. R., Bell Telephone Company, Mackay-Bennett Cable Company, of New York, North American Telegraph Company, and many other corporations of a more or less influential character. The Chaudiere Electric Light Company was organized by Messrs. Ahearn & Soper, with a capital of $400,000, which has since been increased to $500,000, and the stock of the company is now at a premium of 125. For the last four years the firm have employed from forty to fifty men, who are residents of Ottawa, on construction work from spring to fall."

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.

Anonymous communications cannot be noticed.

The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.

In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.

Sketches and drawings for illustrations should be on separate pieces of paper.

All communications should be addressed EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

THE HEDGEHOG TRANSFORMER.

[142.] We notice that you say in a note that a hedgehog transformer is admittedly less efficient at full load than a closed iron circuit. There is a general impression to this effect, but we think it is unfounded. Mr. Swinburne, in his British Association paper last year, showed that a "hedgehog" could be made more efficient than any possible form of closed iron circuit, unless some new brand of iron is discovered.

In England, where low frequencies and high pressure are used, quite small hedgehogs give 95 per cent. efficiency. In America low pressures admit of larger wires, and high frequencies are used, and some transformers we are sending over give 96 per cent. We do not consider full load efficiency of much importance, but this point is worth mentioning.

SWINBURNE & CO.

LONDON, Sept. 25, 1890.

EFFICIENCY OF TRANSFORMERS.

[143.] Mr. Steinmetz's letter, in your issue of Sept. 3, criticises my statement that the maximum value of the primary current corresponds with the zero value of the E. M. F. if there are no Foucault currents, and he points out that if there is also no hysteresis, and if the primary E. M. F. varies harmonically, the primary current does too, and does not lag a quarter of a period, but a little less, so as to allow for the waste of power in the primary coils. This is quite true, and admitted, assuming μ to be invariable, but the primary loss due to the magnetizing current is, I imagine, about $\frac{1}{10}$ of a watt, or something of that sort, and would not show on the curve referred to. I did not, however, refer to the primary E. M. F. in particular, and if Mr. Steinmetz will look up the curve referred to he will find the maximum value of the primary current is also before the zero of the secondary pressure.

Mr. Steinmetz also accuses me of stating that the Foucault current curve must be similar to the primary current curve; I said similar to the electromotive force curve. Neglecting the magnetizing current, it is similar to both primary and secondary E. M. F. curves; so we are agreed as to this point. I cannot see how either Foucault or secondary currents can give back power to the primary circuit unless these circuits have capacity or self-induction. To give the effects in Ryan Plate XIII., p. 19, enormous electrostatic capacity would have to exist in the circuits of the Foucault currents, which is impossible.

Mr. Steinmetz has, I am afraid, misunderstood what I said about the resistance of the incandescent lamps used to measure the primary current. I did not refer to any difference of resistance under a direct and an equal effective alternating current or pressure, but to chance of error through accidental confusion of the instantaneous and the effective pressure on the lamp or lamps. Prof. Ryan has kindly cleared up this point, showing that no such error was made.

JAS. SWINBURNE.

WIMBLEDON, LONDON, Sept. 23, 1890.

THE CANADA-AUSTRALIAN CABLE.

With regard to the projected cable between Canada and Australia, a cable dispatch from Ottawa of October 21 says: "Sir John Pender has informed Mr. Sanford Fleming that he hopes to visit Hong Kong next year by way of Canada, 'traveling by the Canadian Pacific line, when I hope to inspect that wonderful undertaking in which you have played such a prominent part, and at the same time discuss with you the best means of establishing closer telegraphic communication between Canada and the Australian colonies, when the time is ripe for carrying out the work.'"

The friends of the Eastern Telegraph Company have at last to recognize the absolute necessity for an alternative cable to Australia by way of Canada and the Pacific. In the same letter the chairman of the Eastern Company says:

"If the various governments interested are determined to have a line across the Pacific, and are prepared to incur the requisite expenditures for the purpose, I am quite ready, as I have always told you, to co-operate in carrying out the work on fair and reasonable terms. In this way the object might be obtained more easily and economically than if the third parties were employed."

Mr. Fleming says in his reply that the means taken to establish the new telegraphic communication are entirely secondary, provided that the new line be secured.

EUROPEAN CORRESPONDENCE.

LONDON.

Electric Lighting in English Towns.—Electric Lighting in Tramcars.—Telegraphs in Australia.—Telephones in Madrid.—The Johnson Storage Battery.

ALTHOUGH the Electric Lighting Acts clearly define the responsibilities of municipal bodies in respect to lighting, scarcely a week passes by without a stormy meeting, occasioned by the proposed introduction of electricity. The disagreement among the town authorities is followed by a meeting of ratepayers which often-times ends in a row. Similar public meeting have recently been held in Woking and Lewes, but though the friends of electric lighting in the last named place had the best of the argument, the matter was adjourned to enable the worthy townsmen to think over the matter. When the question primarily comes before a Town Council, the plan is usually adopted of sending a few members on a central station tour, which naturally includes London. After having an agreeable time of it and spending a good deal of money (ratepayers'), they return home greatly impressed with the wonders of electricity, and hand the whole business over to a private company.

The towns of Gravesend, Burton, Nelson, Pemberton, Reading, Heckmondwike and Stockport are considering the question of lighting by electricity. It is expected that most of these places will be worked by private enterprise.

An experiment of electrically lighting tramcars has been carried out by means of accumulators.

The report of the Superintendent of Electric Telegraphs of Queensland, Australia, states that there are now 9,662 miles of line and 17,193 miles of wire open for public business. During the twelve months reviewed by the report, great damage has been done to the lines. The total number of interruptions from various causes was 1,007.

The restrictive conditions in regard to telephones which have hitherto held in Madrid, are, I hear, about to be removed. Should this be the case, there will be a considerable development for apparatus somewhere.

A set of secondary batteries, manufactured by the Johnson Electric Supply Company, of Boston, U. S. A., has been exhibited to a few technical men in London. The importers of the battery stated they had the storage battery of the future, as its capacity, efficiency, and durability, as well as cheapness of construction, were absolutely unprecedented. The set shown had been discharged at the works at Boston, and gave a capacity of 260 ampere-hours working at 13.5 amperes; the E. M. F. at the commencement was 22 volts, and at the end of the discharge 18.91 volts. 33 lbs. was said to be the weight of the electrodes in each cell; the total weight of each complete element, however, was not given. The performance certainly was not any better than that of the well known English types of storage batteries. Nothing can be said as to durability, as the oldest have only been in use two years. As to cost, it is not easy to see why the plates on exhibition should be cheaper than those already in the market.

H. S.

LONDON, Oct. 15th, 1890.

CORRESPONDENCE.

PHILADELPHIA.

Electric Cranes for Locomotive Works.—"Protectors" on Telephone Circuits.—Electric Railway Work.—Lapsed Privileges.

A DECIDED novelty in the mechanical world are the two immense cranes in course of construction by William Sellers & Co., of this city, for Baldwin's Locomotive Works. The cranes are being built in the shape of two large bridges, running upon tracks, with two trolleys, or carriages, each capable of lifting fifty tons. Two 40 h. p. electric motors are to be used in operating each crane. The motors are carried on the bridges, and the electricity conveyed to the cranes through two copper rods. The cranes will move rapidly in every way, and are capable of running along the shops at the rate of 200 feet per minute, the hoists from 5 to 40 feet per minute, and the carriages will run across the bridges at 100 feet per minute. The company will also build three smaller cranes for the Baldwins, all to be operated by electricity.

Suit was brought recently against the Bell Telephone Co. by the Brown Electric Protector Co., and damages to the extent of $100,-000 are asked because the Bell Co. recently issued a circular to its subscribers warning them against using the Brown protector on the ground that it is a "fruitful cause of annoyance and interruption." The reason the circular was issued, it is said, is that the Bell Company is interested in the sale of a protector invented by Dr. Plush, general manager of the Bell Telephone Co. in Philadelphia.

The People's Passenger Railway Co., of this city, contemplates introducing an ordinance in Councils asking permission to erect poles and electric wires on the Lombard and South streets branch. This includes both streets east of the Schuylkill River to Front street, and north on Front street to Market. In West Philadelphia, the line is known as the West End Branch, which is leased by the Lombard and South.

The ordinance will include Lombard and South streets as far west as Woodland avenue, Woodland avenue to Thirty-ninth street, and Baltimore avenue to Angora. It is said that the Spruce and Pine Streets Road will also ask permission to erect poles and electric wires.

The residents of the extreme western portions of West Philadelphia are urging the Traction Company to provide for the more frequent running of cars from the depot at Forty-first street, and to extend their tracks further west. Electric cars run by the overhead wire system are also wanted. A committee has been appointed to wait upon the officials of the company and request them to make these changes.

Another improvement will be the extension of the present line, running from Eighth and Dauphin streets to Chestnut Hill by way of Main street. The company is disposed to do away with its horses, if Councils grants it permission to erect overhead electric wires for the use of its cars. If successful in this attempt six four-inch iron poles, neat in construction, will be placed in every square of road over which the line is operated. Three such poles, in place of the ugly and unsightly telegraph poles, will be placed on each side of the street, and each pole will carry five incandescent lights. This illumination of the streets will be furnished to the city free. At present the cars are run on eight-minutes time. Under the proposed plan the cars will be run every three minutes.

The Traction Company also has in contemplation some important extensions, which will do a great deal toward developing hitherto neglected portions of the city. Electricity will be the motive power and surveys of the route have already been made, and it is expected that the work of construction will begin next year.

In response to a resolution passed at the last meeting of Select Council the Mayor sent that body this list of electrical companies which have not availed themselves of privileges granted by Councils: Atlantic and Pacific Telegraph, Municipal Telegraph, Underground Electric Conduit, Metropolitan Underground Telephone, Telegraph, Electric Light and Power, Continental Underground Cable, Morse Underground Conduit, People's Underground Electric Light, Cosmopolitan Telephone, Telegraph, and Electric Light, Bankers' and Merchants' Telegraph, Electro-Pneumatic Transit, Philadelphia Time Telegraph, Western Union Telegraph, and Postal Telegraph. The privileges of most of these companies under the license granted by Councils have expired. Mr. Moffett moved that a special committee of seven members from each Chamber be appointed to consider the report, which was agreed to.

PHILADELPHIA, Oct. 25, 1890.

PITTSBURGH.

Westinghouse Manufacturing Extensions.—Electric Railway Work.—Electricity in the Mines.

THE Westinghouse Electric & Manufacturing Company has just completed some very extensive improvements in the factory on Garrison alley, in this city, for the purpose of increasing the capacity of the street railway motor department. The company has added a number of new tools to the machine shop, and by that means the production of the motors will be much larger than it has been heretofore. The motor department has been increased by six gear cutting machines manufactured by Gould & Eberhardt; one Knowles key-seating machine; twenty new lathes have been added, as well as two new drill presses, six milling machines, two planers, several shapers and a special boring mill.

By the first of December, so it is promised, the Duquesne Traction Company will have its system of electric roads in operation. The company's lines cover the largest part of Pittsburgh, extending altogether for about twelve miles. Forty cars will be operated on the road, and the Pullman company is about to ship the first lot of them very shortly. The big power house is about completed and motor generators have been placed in position.

The Braddock borough council a few days ago granted the right of way through the town to the Braddock Electric Street Railway Company, which contemplates building a road through Braddock borough and township to connect with the Duquesne Traction Company's lines at Wilkinsburg. Work will be commenced almost immediately, and the cars are to be in operation in less than a year.

The Squirrel Hill Electric Railroad has been sold at auction for $25,000. The name of the purchaser could not be learned, but it is understood that the road was bought by the Pittsburgh Traction Company, and that that corporation intends to go immediately ahead and finish the construction of the line. When completed,

it will open up one of the most desirable locations of Pittsburgh for private residences.

The authorities of Kingwood, Va., are now making an investigation into the different systems of electric lighting with a view of establishing a plant to light up the streets and public buildings.

The introduction of electricity in the coal mines of Pennsylvania is finding great opposition among the coal miners, who aver that the electric mining machines displace a number of men. The coal operators, however, do not pay much attention to this agitation, and mining machines are becoming more general every week. The operators state that the introduction of mining machines operated by electricity is the only means they have by which they can make their business pay. When the production of coal depended chiefly upon the miners, the cost of operating a mine was so large, and miners' wages were cut down so low that no Americans could be induced to work at coal mining. The coal business was in fact going down from bad to worse. In this emergency the advent of the mining machine was hailed with delight by the operators, and wherever mines are using electric power the company not only can afford to pay its men good wages but the business also makes a good profit to the operators.

PITTSBURGH, Oct. 24, 1890.

BOSTON.

Wire Matters.—Electric Elevated Railroads.

THE main office of the Western Union Telegraph Company's building, at 109 State street, was somewhat damaged by fire this week by one of their wires coming into contact with an electric light wire, caused by the high wind storms. The damage was, however, slight, and business was only hindered for a day or so.

At a meeting of the Common Council the ordinance for the regulation of the supervision of electric wires was assigned to the next meeting.

At a meeting of the Board of Aldermen the Edison Electric Illuminating Company was authorized to lay and maintain underground conductors for electric wires in a number of streets. The same privilege was extended to the Western Union Telegraph Company. Through the efforts of Aldermen Wilson and Carruth the privilege of opening those streets is limited to December 31.

The Street Commission gave a public hearing this week on the proposed widening of certain streets, and the making of new streets, required for the elevated road of Boston, should it be granted the privilege of building. Mr. H. M. Whitney, in the interests of the West End Street Railway Company, made an eloquent address, giving many statistics of the amount of daily travel in Boston, and maintained that whether an elevated road were built or not, the changes proposed would be of immense value to the city, predicting that if they were not made now they would have to be made some time, at a much greater cost, to relieve the daily increasing traffic on Washington street. In the course of his remarks he made the following statement, which I give verbatim, as it may serve as an encouragement to some street railway magnates who are hesitating about adopting electricity as a means of propulsion: "If our experience stands for anything in connection with the introduction of the electric system, it shows this—that where people traveled once over the horse car system before the electrics were put in, somehow or other there is a very large increase, in some cases amounting to almost 50 per cent." The hearing was adjourned, and will be continued next Monday, the 27th inst.

BOSTON, MASS., Oct. 25, 1890.

CHICAGO.

Opposition to Overhead Lines.—New Alternating Current Motor.—Meeting of the Electric Club.

THE electric companies in Hyde Park and Englewood are having some trouble with their overhead wires. The Hyde Park District Telegraph Company and the Englewood Electric Light and Power Company started to erect poles along Sixty-first street last week. Each company endeavored to forestall the other, when the citizens stepped in and put an end to the quarrel by petitioning Commissioner Purdy yesterday against the poles. He revoked the permits of the companies and sent to each of them a letter ordering them to make a plan of the streets upon which they have rights and to specify in detail what they propose to do.

Your representative recently witnessed the performance of an alternating current motor which appears to possess some remarkable points of merit. This machine is the invention of Mr. Wm. M. Dresskel, of Brainerd, Minn., and is the perfected outcome of an immense amount of work done by Mr. Dresskel in this line. The machine is of the multipolar type, fitted with a peculiar form of commutator, and operates equally well either on the direct or on the alternating current without any changes being made in the machine. It requires but two wires, and can be attached anywhere between the secondary mains of an ordinary installation, when it will start in the direction desired, is instantaneously reversible by a turn of the switch, and starts up with quite a powerful torque. In fact, it seems to meet a long felt want, and if the large sizes give equally satisfactory results it will receive widespread adoption.

On Monday evening, Oct. 19th, the first regular meeting of the Club was held, being preceded by a meeting of the board of managers, when the following gentlemen were elected as resident members: John P. Barrett, Chas. A. Brown, George S. Searing, Robt. C. Clowry, Elisha Gray, W. J. Chalmers, Thos. M. Brooks. E. R. Gilman was elected a non-resident member.

After the meeting of the board of managers, at which various committees were appointed and vacant posts filled, the regular club meeting took place, in the parlors of the club; in the absence of President Beach, Prof. Badt, first vice-president, occupied the chair. Mr. B. E. Sunny then read a most interesting and able paper on "The Central Lighting Station as an Investment." Prof. Badt gave notice of certain amendments to the by-laws, the same to be posted in the club rooms, the principal among which was that resident members shall pay an entrance fee of $50 and annual dues of $40. On recommendation of the board of managers an assessment of $10 was ordered to be levied on all the members.

CHICAGO, Oct. 22, 1890.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the regular monthly meeting of the Council held on Oct. 21, the following gentlemen, 19 in number, were, on examination and approval of credentials, duly admitted to associate membership:—

Abbott, Arthur V., Mechanical Engineer, United Electric Traction Co., Closter, N. J.

Bulkley, J. Norman, Superintendent, U. S. Aluminum Metal Co., Boonton, N. J.

Colley, Benjamin W., First Ass't Superintendent, The Commercial Cable Co., Hazel Hill, N. S.

Fessenden, Reginald A., Assistant Electrician, U. S. Electric Light Co., Newark, N. J.

Fitch, Graham D., First Lieut., Corps of Engineers, U. S. A., Duluth, Minn.

Gaines, J. D., Second Ass't Superintendent, The Commercial Cable Co., Hazel Hill, N. S.

Lloyd, Robert McA., Electrician of the Marion, N. J., Factory, United Electric Traction Co., 2 W. 36th St., New York City.

Martin, F., Inspector of Isolated Plants, Edison Electric Illuminating Co., of N. Y., 16 Oak St., Newark, N. J.

Martin, J., Electrician, Hanson, Van Winkle & Co., 16 Oak St., Newark, N. J.

Miller, Wm. C., Gen. Man., Watervliet Turnpike & R. R. Co., 3 South Hawk Street, Albany, N. Y.

Perkins, Frank C., Student in Electrical Engineering, Cornell University, Ithaca, N. Y.

Reid, Thorburn, Consulting Electrical Engineer and Expert, 15 Wall and 26 E. 33d Sts., New York City.

Rosenberg, E. M., Supt. Manhattan E. L. Co., 80th St., and Ave. B., residence, 784 Lexington Ave., N. Y. City.

Schmid, Albert, Superintendent, Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Sheble, Franklin, Electrical Engineer, Thomson-Houston Electric Co., Lynn, Mass.

Watson, Robert, The Elektron Mfg. Co., 79 Washington St., Brooklyn, N. Y.

Webb, Herbert Laws, Assistant Electrician, The Metropolitan Telephone and Telegraph Co., 18 Cortlandt, N. Y. City.

Weller, Harry W., Railroad Inspector, The Edison General Electric Co., Edison Building, Broad Street, and Jamaica, N. Y.

Wright, John D., Electrician's Assistant, United Electric Traction Co., 107 Garrison Ave., Jersey City, N. J.

The same evening, the monthly meeting of the Institute was held, President Anthony in the chair, when a paper was presented, entitled, an "Investigation of the Stanley Alternate Current Arc Dynamo," by W. B. Tobey and G. H. Walbridge. A brief description of the machine was given, and curves shown, giving diagrammatically the values of E. M. F. current, and watts for any part of a complete period; also the position of these curves relatively to the poles for different loads, thus showing the method of regulation; also curves of efficiency and regulation. The methods of obtaning these results was outlined.

Mr. Thorburn Reid also presented "A New Method of Analyzing Armature Reactions, Applied to the Stanley Arc Light Alternating Current Machine," printed for distribution at the meeting.

A motion was introduced by Mr. T. C. Martin and carried, giving the support of the Institute to the petition of the National Electric Light Association, asking Congress for a special census and report on the electrical industries of the country and for the sum of $50,000 to be placed for that purpose in the hands of the Census Office.

FINANCIAL MARKET.

QUOTATIONS ON ELECTRICAL STOCKS.

Mr. F. Z. Maguire, Electrical Securities, of 18 Wall street, this city, reports the following quotations of October 25th, from New York, Boston and Washington:

NEW YORK.

	BID.		BID.
W. U. Tel. Co.	81	Edison Gen. Elec. Co.	95
American Tele. & Cable	83	Edison Gen. Co. Def'd	88
Centl. & So. Amer.	155	Consol'd Elec. Lt. Co.	...
Mexican	208	Edison Illn'g Co. N. Y.	68
Com. Cable Co.	100	U. S. Elec. Lt. Co.	30
Postal Tel. Cable	39	North Am. Phonograph	....

*Ex. Dividend.

BOSTON.

	BID.		BID.
Thomson-Houston	51¼	Ft. Wayne Co.	12¼
" Pref'd.	26¼	Am. Bell	226
" Series C.	11¼	Erie	50
" " D.	6¼	New England	52
" Int. Co.	....	Mexican	.75 cts
Thomson Welding Co.	185	Trop. American	..
Thomson Eu. Welding	60	Edison Phon'gph Doll	2

WASHINGTON.

	BID.		BID.
Penna. Telephone	25	U. S. Elec. Lt (Wash.)	150
Ches. & Pot. Telephone	68*	Eck.&Sold. Home Elec. Ry.	65
Amer. Graphophone	14¼	Georgetown & Tenallytown	49

*Ex-Dividend.

PITTSBURGH.

	BID.
Westinghouse Electric and Manufacturing Co.	29

BROOKLYN INSTITUTE—ELECTRICAL DEPARTMENT.

At the regular meeting October 24th, of the Electrical Department of the Brooklyn Institute, twenty new members joined the department.

On account of Dr. S. S. Wheeler's illness, his promised lecture on "Some Applications of Electricity" had to be postponed, but the time was ably filled in by Prof. Samuel Sheldon, with a few remarks on "The Magnetic Circuit," and Mr Hewitt's discussion of "Some Electric Railway Questions."

On Friday, October 31st, an exhibit of electric batteries of various forms, will be given by members and other electricans in the lecture hall of the Union for Christian Work, 67 Schermerhorn street, near Court street, Brooklyn.

ELECTRIC MINING IN EL DORADO COUNTY, CAL.

The first practical demonstration of electric transmission of power for mining purposes in California has been inaugurated by the American River Syndicate in El Dorado County—an English organization under the management of Mr. George Cullen Pearson. The power station is located on Rock Creek, some 1,500 feet below the mine and mill and two miles distant in a straight line.

The plant consists of an 8-foot Pelton wheel, which, running under a head of 110 feet at 100 revolutions with a 5½ inch nozzle, has a maximum capacity of 130 horse-power. To this wheel is connected a 100-horse-power Brush generator, speeded at 900 revolutions, the current from which is carried to the mill through a single insulated copper wire, No. 3, B. & S. gauge, the return being made by a wire of the same size, making a four-mile circuit. The power from the generator is communicated to the countershaft of the mill by a 70 h. p. Brush motor running at 950 revolutions.

The machinery-operated consists of three centrifugal roller mills, a ten-stamp battery and a rock breaker. The Pelton wheel under these conditions shows an efficiency of 86 per cent., while 85 per cent. of the power thus generated is available for duty at the mill, though only 70 per cent. was called for in the contract with the Brush company. Sufficient power is taken from the main circuit to run sixty incandescent lamps for lighting the works, the current being cut in by means of the Brush multiple series cut-out box, which admits the incandescent lights being operated by a high-tension current.

The company owning their own water right, the operating expenses of this plant are almost nominal; only one attendant is required at the power station, and this not an electrical expert, but one of the company's employés. This equipment has now been in constant operation for five months and is a most pronounced success, no interruption to the service of any moment having occurred during this time. The mills named are handling an average of 4,000 tons of ore per month, effecting a saving of some 60 per cent. over the former method of working by steam power, estimating wood at $3.50 per cord, while the cost of maintenance is about as 5 to 1 in favor of electricity.

INVENTORS' RECORD.

Patents issued October 21.

Alarms and Signals:—*Electrical Water-Alarm*, F. M. Ashton, 438,598. *Electric Guest-Call*, A. Striemer, 438,658. *Electric Station Indicator*, G. H. Kirwan, 439,015.

Clocks:—*Electro-Pneumatic Clock*, V. Popp, 438,767.

Conductors, Conduits and Insulators:—*Insulating Composition*, A. E. Menuez, 438,698. *Device for Automatically Insulating Broken Wire*, M. Kerstein, 438,814. *Insulator*, F. Miro, 438,934.

Dynamos and Motors:—*Alternating-Current Generator and Motor*, C. S. Bradley, 438,602. *Electric Motor*, C. S. Bradley, 438,603. *Electric Motor*, E. Thomson, 438,656. *Brush-Holder for Dynamo-Electric Machines*, C. F. Winkler, 438,668. *Apparatus for the Rythmic Generation of Electric Currents*, C. Langdon-Davies, 439,017. *Electrical Transmission of Power*, W. Stanley, Jr., 439,042.

Lamps and Appurtenances:—*Arc and Incandescent System*, J. E. Giles, 438,619. *Electric-Light Pole*, P. J. Dinn, 438,773. *Extension Device for Incandescent Lamps*, S. O. and M. A. Newton, 438,779. *Arc Lamp*, J. Kent, 439,011. *Device for Raising and Lowering Electric or Other Lights*, D. B. Matson, 439,023. *Electric-Lamp Socket with Regulating Attachment*, W. F. Wallin and E. H. Werline, 439,047.

Metal-Working.—*Process of Electric Welding*, E. Thomson, 438,657. *Electric Welding of Pipes*, E. Thomson, 438,658. *Electric Blank Heating and Feeding Apparatus for Forging Machines*, G. D. Burton, 438,723. *Electric Drill*, G. Buchanan, 438,837.

Medical and Surgical.—*Electrical Speculum*, S. H. Linn, 438,891.

Measurement:—*Portable Reflecting Galvanometer*, C. P. Frey, 438,882.

Miscellaneous:—*Electric Crossing-Gate*, H. Gillette, 438,620. *Thermal Cut-Out*, G. H. Whittingham, 438,721. *Electro-Magnet*, F. M. Schmidt, 438,780. *Lightning Arrester*, A. C. White, 438,788. *Time Recorder*, H. R. Adams 438,831. *Magneto-Electric Transmitter*, A. E. Todd, 438,870. *Magnetic Separator for Paper Pulp*, F. H. Richards, 438,897. *Electrically-Controlled Lock for Fire-Arms*, A. von Derschau, 439,055.

Railways and Appliances:—*Motor-Car*, E. Verstraete, 438,719. *Electric Railway*, R. M. Hunter, 438,847, 439,069 and 439,070. *Trolley-Switch for Electric Railways*, H. W. Marcy, 438,894.

Secondary Batteries:—*Secondary Battery*, E. M. Reynier, 438,827.

Telephones and Apparatus:—*Telephone-Transmitter*, A. J. MacDonald, 438,631. *Telephone*, A. J. MacDonald, 438,632. *Telephone*, J. C. H. Stut, 438,784. *Telephone*, J. W. McDonough, 438,818. *Telephone*, W. L. Richards, 438,828. *Telephone Exchange Apparatus*, F. G. Beach, 438,962.

REPORTS OF COMPANIES.

AMERICAN BELL TELEPHONE OUTPUT.

The Bell Telephone Company reports the net output of instruments for the month ended October 20, as 3,173, a decrease of 198 compared with last year. This makes 476,333 instruments in use October 20, a gain of 2,976 over a year ago that date. The statement is as below:

Month Oct. 20.	1890.	1889.	Increase.
Shipments	5,378	5,152	226
Returned	2,205	1,781	424
Net output	3,173	3,371	*198
Since Dec. 20.	1889–90.	1888–89.	
Shipments	53,787	48,394	5,393
Returned	22,315	19,898	2,417
Net output	31,472	28,496	2,976
Instruments in use Oct. 20	476,333	440,037	36,296

*Decrease.

ELECTRIC RAILROADING AT SPRINGFIELD, MASS.

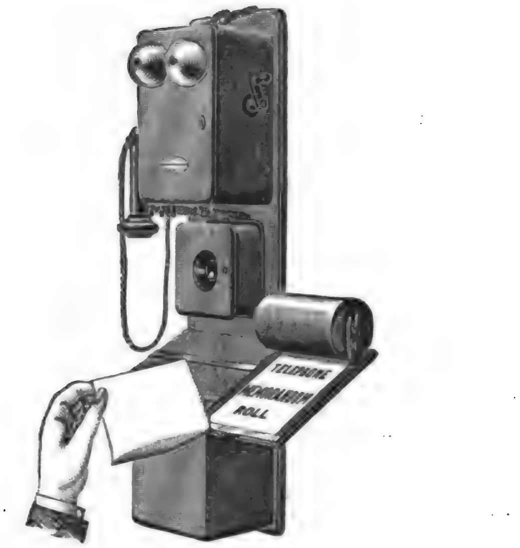
In our last issue, mention was made of the fact that the Springfield Street Railway Co. were going in for electric traction. The company has a capital stock of $400,000, and Mr. S. W. Munsell writes us that it will petition the State Board of Railroad Commissioners for leave to increase the capital stock $300,000. At the meeting held Oct. 18, it was voted to authorize the directors to adopt the overhead system, and to petition the city government for overhead privileges. John Olmstead is president of the company, and A. E. Smith, manager. It is understood that a Westinghouse car or two will be put on the road as soon as possible, and that the Holyoke Street Railway Co. will follow the Springfield example as to the adoption of electricity.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT

TATUM'S TELEPHONE ATTACHMENT.

The frequency with which orders are transmitted by telephone, and the numerous other occasions when it is desirable to make a record of the conversation, renders a convenient tablet alongside the telephone a thing of necessity. To afford a convenient adjunct to the telephone the Tatum telephone attachment, which is illustrated



TATUM'S TELEPHONE ATTACHMENT.

in the accompanying engraving, has been designed. As will be seen, it consists of a small tablet provided with a roll of paper. The arrangement is attached to the side of the box without the use of a screw, which telephone companies forbid, and hence can give rise to no objection from that quarter. The paper being in the form of a roll it is always in place, and there are no waste or loose leaves. The board is made of walnut, with nickel-plated trimmings. Messrs. Tommins & Adams, of 116 Chambers street this city, are the sole agents for the attachment.

WESTERN WORK OF THE THOMSON-HOUSTON CO.

The Chicago City Railway Co. have for some years been using a Thomson-Houston incandescent dynamo for lighting their power house and offices near the corner of 20th and State streets, with such good economy and satisfaction, that they have decided to adopt the same system for lighting the new power house at the corner of 61st and State streets. It is much to the credit of President Holmes that he has been quick to avail himself of the many advantages afforded by the use of electricity, as indicated by his adoption of it on many of the street railway lines, outside of Chicago, in which he is interested, notably, Moline, Rock Island, Davenport and Indianapolis, and also for the purpose of lighting his power houses. The fact that he has adopted the Thomson-Houston system to the exclusion of others, may be looked upon as an indication that the system is all that its promoters claim for it.

Last month, the Illinois Steel Co. ordered of the Western Isolated Lighting Department of the Thomson-Houston Electric Co. a 30 arc light plant for their works at South Chicago. They have, during the past week, placed another order for a 35 arc light plant to be installed at the same place. This plant was delivered and set up ready for operation the day following that upon which the order was given. From this, it would appear that, even though the Thomson-Houston Co. do an enormous business, they manage to take care of it in a manner that tends to disprove the old adage that "large bodies move slowly." The day is not far distant when a man can drop into an electric light company's office in the forenoon, place his order, and find upon his arrival at home in the evening, that the wiring is finished and lights are ready to turn on, to furnish illumination for his dinner table.

Dernberg, Glick & Horner, N. E. corner State and Adams streets, Chicago, who were reported last week as having closed with the Thomson-Houston Co. for a 45 arc light plant, have also been equipped with an incandescent lighting outfit. This concern has recently started a large department store to be known as the "Leader" and they evidently appreciate the value of electric light, as besides purchasing isolated arc and incandescent plants, they have also contracted with the Chicago Arc Light & Power Co. for some arc lights to be suspended over the side-walks, on both Adams and State streets.

A DISTRICT BEER-CALL SYSTEM.

Quite a novel application of electricity is reported from an enterprising town in Texas, it being practically a system of district calls in answer to which a supply of beer is sent to any of the call stations. It so happens that a wide-a-wake merchant controls all the saloons in the place, as well as some ice-houses, and in order to save the expense of keeping a stock at each saloon he has hit upon the call system as the simplest and best medium. He accordingly carries but a small supply at each of the refreshment places, and keeps the bulk of beer and ice at one central point, from which a fresh lot can be promptly sent to any of the saloons on receipt of call from that point. The cost of installing the system is so low that it is expected to pay for itself very quickly by the saving effected in ice, to say nothing of the valuable additional convenience of such a service. The Great Western Electric Supply Company, of Chicago, have furnished the apparatus and supplies, and are confident that similar systems will be installed for use with other lines of merchandise, especially in the Southern and Western towns.

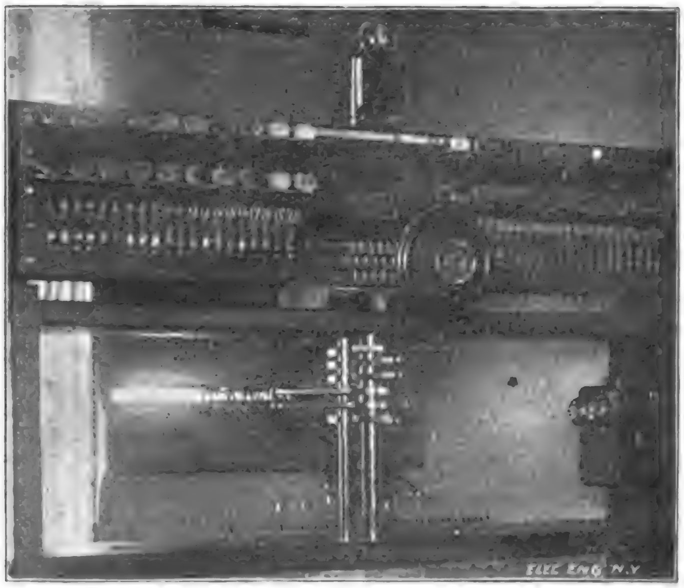
PROGRESS OF THE RAE ELECTRIC RAILWAY SYSTEM.

The Galveston, Tex., City Railway Co. has contracted with the Detroit Electrical Works, for a full electrical equipment of Rae motors and generators. The first installment of twenty motor cars and four generators with full station equipment, will be in operation on or before Jan. 1st, 1891. Col. Sinclair, president of the Galveston Railway system, made very exhaustive investigations of the various systems and his ultimate decision is a very high compliment to the Rae system.

The Detroit Electrical Works have forwarded to Portland, Ore., the first shipment of their standard 30 h. p. motors and trucks (Rae system), as the forerunner of a large order.

THE SHAVER TELEPHONE EXCHANGE AT LITTLETON, N. H.

The introduction of the Shaver mechanical telephone is being pushed with considerable vigor and one of the more recent installations is that of the exchange at Littleton, N. H. This exchange, which is illustrated in the accompanying engraving, has a capacity of 40 subscribers.



SHAVER MECHANICAL TELEPHONE EXCHANGE, LITTLETON, N. H.

The routes comprise numerous angles, the longest line being about three-fourths of a mile, and the longest connection through central is about one and three-eighths miles. According to local reports, the articulation is very satisfactory. The price charged for the service is $15 per annum; and the exchange is located in a drug store, where it is operated by the regular clerks.

The Shaver Corporation intend to install similar exchanges in neighboring towns in the same district.

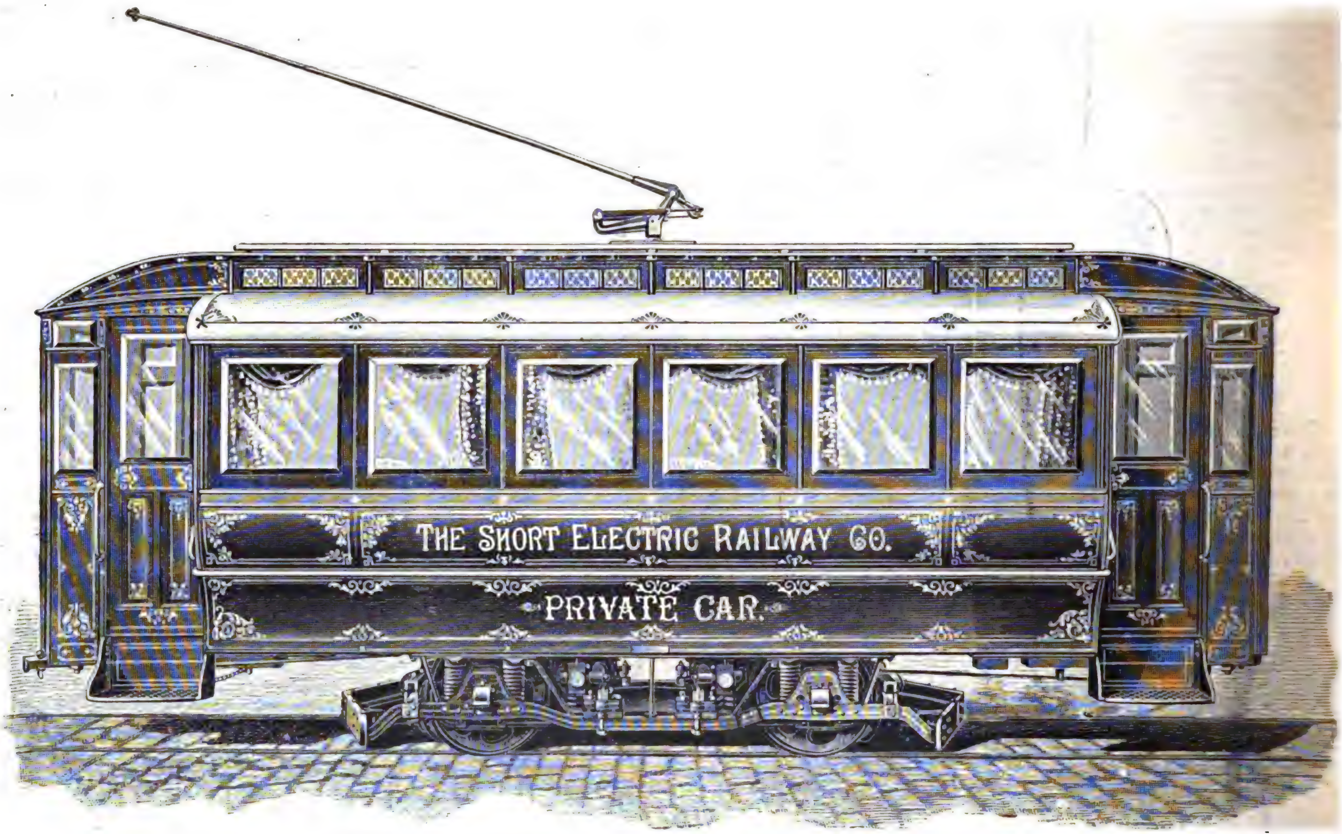
PRIVATE CAR OF THE SHORT ELECTRIC RAILWAY CO.

We present herewith a view of one of the most elegant and elaborately furnished electric street cars ever turned out from an American car shop. We are indebted to the *Street Railway Journal* for the engraving. The car, the body of which was built by the Gilbert Car Manufacturing Co., of Troy, N. Y., is intended for the use of the president of the Short Electric Railway Co. It is of the vestibule type, eighteen feet inside length and twenty-six feet over all.

The car and truck are painted black. The body is of carriage finish, ornamented with gold leaf and hand painted designs.

The truck which carries this car is from the J. G. Brill Co., Philadelphia, and is known as their No. 7 independent rigid motor truck. The car rides very easily on the running gear, which we understand is well liked by the Short company. The Stanwood perforated steps are used and the handles of the switch and brake levers are of bronze.

The interior finish is very handsome indeed. The headings are of embossed leather nailed on with medallion headed tacks; there are small panels of ornamented light-colored wood which relieve the sombre color of the leather, and from the two end panels the group of incandescent lamps are hung, each group having glass shades of different designs.



Short Electric Railway Co.'s Private Car, Cleveland, O.

The large heavy beveled glass windows are shaded by heavy silk damask curtains. The wood work is all mahogany and is wainscoted from floor to windows, and between every other window is a carved pilaster.

The furniture consists of twelve handsome rattan chairs in pairs, of different designs, some with high rolling backs and others with low backs and curved arms; they are upholstered in old-blue plush, almost a slate color, and the window ledges are covered with the same material. Corner chairs of rattan fit two diagonal corners and the other two have low stools upholstered with lockers underneath. Rich carpeting covers the floor.

The car is to be operated upon the company's tracks about the works in Cleveland, and will always be held in readiness to take the company's guests over any of the electric lines in the city. The company's tracks and trolley wire are connected with those of the East Cleveland line from which the current is derived for operating the works line, and which has switches connecting with the other city lines. This private car was on exhibition at the recent street railway convention at Buffalo, and was one of the most attractive features among the exhibits, hundreds of people passing through it every hour.

THE "A. B. C." INCANDESCENT LAMP.

Among the many evidences of enterprise on the part of the vigorous young firm of Alexander, Barney & Chapin, 20 Cortlandt street, is their production of a new incandescent lamp, which they call the "A. B. C." It is a lamp made under new and improved processes and for either high or low volt circuits. It is of excellent and symmetrical shape, and gives a clear pure, white light of the highest photometric value. It is made for any candle power.

The firm also announce that they handle Edison lamps at Edison prices, and carry all kinds of Edison supplies for central stations and isolated plants. Keeping an eye also on the rapid development of the new field of electric railroading, they are handling Thomson-Houston and Edison electric railway supplies. The indications are that they will be kept very busy in electric railway work. They are also giving their attention to wood screws and machine screws, especially adapted for electrical purposes. They are now carrying also a full line of line wires, office wires, magnet wires, etc., as well as underground cables of high insulation; electrical books, and a magnificent assortment of measuring and testing instruments. In fact, it would be hard to say where they draw the line, as they regard the whole boundless continent of electricity as their field.

W. R. FLEMING & CO.

W. R. Fleming & Co., of 174 Fulton street, New York City, the selling agents for the "Ide" and "Ideal" engines, simple and compound, and other manufactures of the foundry and machine department, Harrisburg, Pa., including steel return tubular boilers, report that they have just closed a very large contract for a complete steam plant to go to Mexico. This is the second order on account of the same electric company. Fleming & Co. state that they are having a great run on their engines, particularly the "Ideal," which is a centre crank automatic self-oiling engine. It is built very heavy for severe duty, and is held in great favor by the electric light and street railroad companies because of its simplicity, wonderfully close regulation, and little care it requires when running. All parts of the engine run in oil, and are accessible while the engine is in operation, without the removal of a single bolt or screw. Their side crank "Ide" engine is, they say, leading the market in the sale of its class.

NEW ENGINES OF THE FITCHBURG STEAM ENGINE COMPANY.

BY W. E. SHELDON.

THE economical use of fuel is a question pressing more and more upon manufacturers in this country, as competition reduces profits to a very small margin. This condition of things for the past few years has made the demand for a thoroughly economical engine, and this demand has been met by the production of the best compound and triple expansion types of engine. Where water can be easily obtained and the cost is slight, the subject of condensing and compounding will well pay a close investigation by any one thinking of purchasing an engine. In a compound engine, not only is the power increased at a less cost for fuel, but there is required but about two-thirds the usual boiler capacity to develop a given power and it is often true that sufficient additional power can be supplied for a large increase in the machinery of a mill without any increase of boiler plant and with a large saving in fuel. In the use of power for electric lighting and railway purposes the question of producing this power with the smallest quantity of fuel, has become a very important item, and the amount of money saved by using a good compound engine means so much toward a dividend to the stockholders at the end of the year. To meet the present demand for a first-class compound engine, we are prepared to furnish our "cross," our "twin" compound, "tandem" compound or high speed compound engines. Fig. 1 in this article represents our "cross" compound low speed engine, such as we are putting in for a great many electric light companies and street railway companies. In this engine we use our regular balanced double ported, piston valve, made positively expansible so that it can be kept perfectly tight at all times without any expense. The inlet valves are actuated by a wrist plate motion, giving a very sharp cut-off of steam and are worked

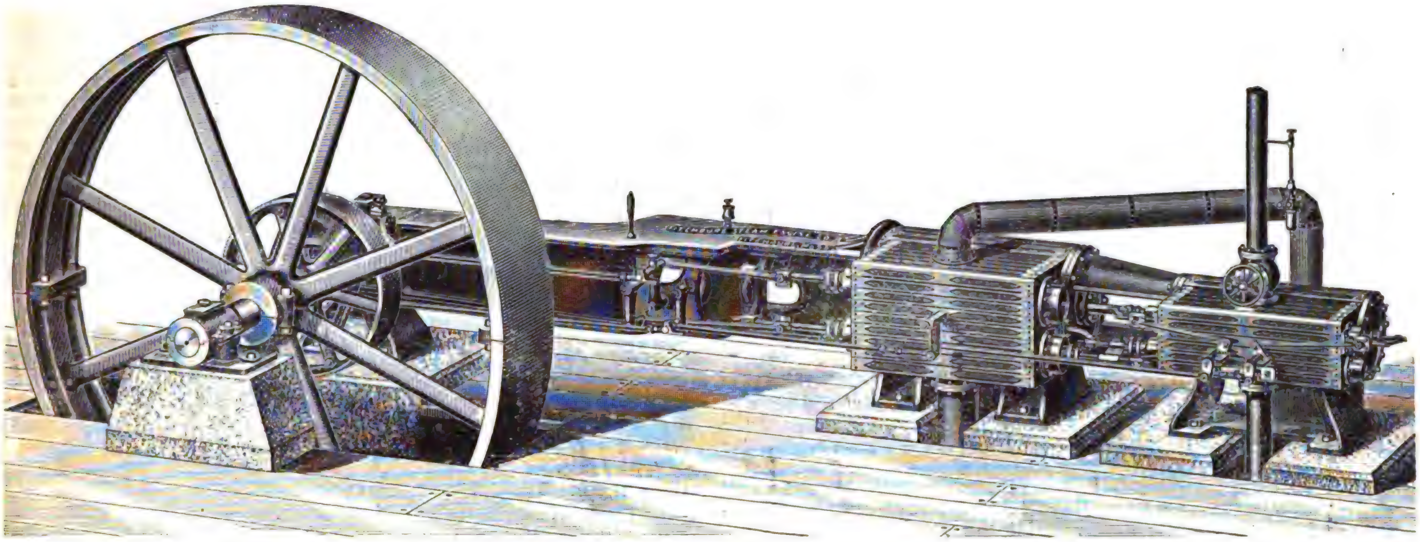


FIG. 2.—TANDEM COMPOUND ENGINE, FITCHBURG STEAM ENGINE CO.

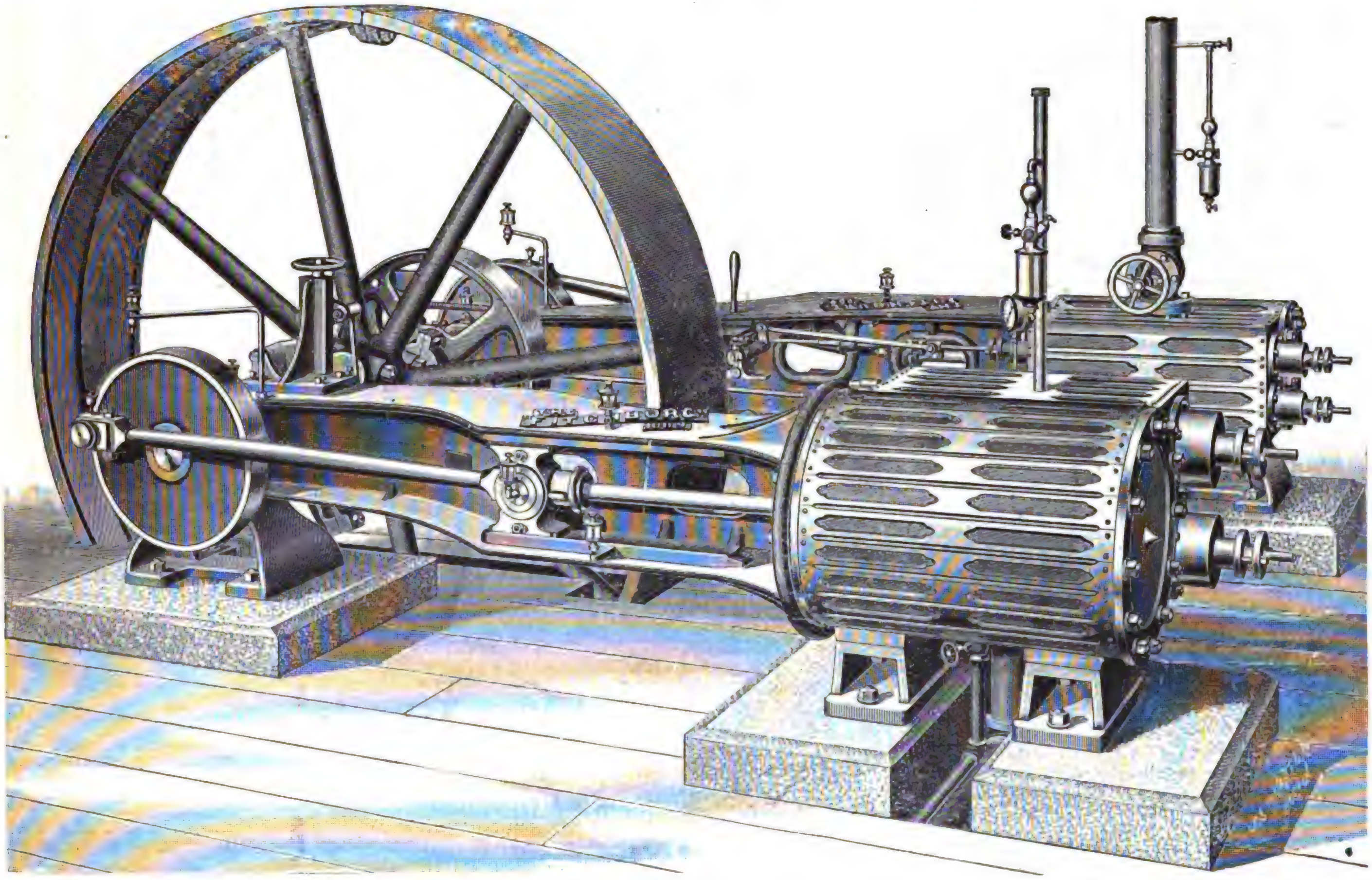


FIG. 1.—CROSS COMPOUND LOW SPEED ENGINE, FITCHBURG STEAM ENGINE CO.

directly from our shaft governor, the exhaust valves being run independently from an eccentric on the shaft.

Between the high pressure and low pressure cylinders we use a reheating receiver, the steam passing from the high pressure cylinder into the receiver, being superheated by means of live steam passed through the coils of the receiver. By this means we obtain the very best results when the steam reaches the low pressure cylinder. In the construction of these engines we have retained the first-class features of our regular horizontal engine, which is so well known in electric light circles. We use only the very best of material and workmanship in our construction, and we build all parts strictly in duplicate. This latter is a very important item, as accidents will happen in all engines. Our connecting rod boxes are of solid hard bronze: the crank and crosshead pins are of hardened steel, ground perfectly true after hardening; piston rods and valve rods are of steel, the valve rods being hardened and running in bushings inside the stuffing boxes; the connecting rods and shafts are solid forged iron and everything is of the very best throughout. The governor is of the "shaft governor" type, but unlike the majority of shaft governors, the large frictional surfaces are entirely done away with, thus preventing the sticking, and consequent jumping, of governor. We are at present putting in of this type two 250 h. p. engines for the Powelton Electric Light Co., Philadelphia, also two of 400 h. p. for the Suburban Electric Light Co., Tacony, Pa., and we have many others in use in electric light plants, as well as other places. As we use a short stroke we have an engine which takes up less room in length than that of many of our competitors.

In the second cut, Fig. 2 we represent our "tandem" compound engine, having both cylinders in one line, one cylinder in front of the other using one piston rod and one connecting rod for the two. This engine is sometimes better adapted for particular conditions than our "cross" compound, as it takes up considerably less room in width, although a little more in length. In this engine we use the same reheating receiver between the two cylinders and practically the same valve motion.

In addition to the two cuts shown we have also a strictly high speed engine, with centre crank, having two fly wheels, one on either side, and this we also furnish compound and compound condensing. We have had a large experience in fitting out complete power plants in electric light stations and are prepared to give estimates for complete plants, including engines, boilers, foundations, pumps, heaters, smoke stacks, etc., turning over to the purchaser the plant in complete running order.

THE WESTINGHOUSE ELECTRIC RAILWAY SYSTEM IN GREENSBURG, PA.

Last week, the Greensburg and Hempfield Electric Railway Company, of Greensburg, Pa., started the operation of their street car line. The road runs from the Pennsylvania railroad station through the principal streets of the town to Hempfield, a small suburb of Greensburg, a distance of 2¼ miles.

Greensburg had heretofore no street car line of any kind and the commencement of rapid transit by the electric system was quite an event in the history of the town. All the local papers had made an announcement of the occasion and of the hour at which the first car would come along the streets, and the public came out en masse to witness the turn out.

The road is operated with the Westinghouse system of electric motors and were not the success of that system already established, Greensburg afforded an excellent opportunity to make the final tests.

As was already stated above, the road is 2¼ miles long. In covering this distance, the cars have to climb no less than eight hills, and the majority of these hills incline at a grade of 10 per cent. In addition to the hills, however, the line is also peculiar on account of the large number of curves, all of them short ones. But in spite of all these obstacles to an easy and smooth operation of the motors, it is satisfactory to note that they have given more than excellent service from the moment the first car rolled out of the shed.

Owing to the novelty of rapid transit in Greensburg generally and of electrically propelled cars in particular, the Greensburg residents have taxed the capacity of the cars to their utmost limit. Every car has hitherto been crowded from the starting point to the terminus and return, the cars having carried on the average 75 passengers right along.

The track is composed of the Johnstown rail and the T-rail. With the exception of a short distance in the business portion of the town, where the tracks are laid on asphalt covered streets, the road bed has been stone ballasted.

The power house is situated near the terminus of the road at the foot of one of the steepest hills along the entire route. It is very comfortably arranged. The car shed and a repair shop are immediately attached to it, everything being situated level with the ground.

The motors are placed upon Brill trucks and the bodies of the cars are made by the Chester Car Company. The latter are very commodious and handsomely painted.

Mr. F. Y. Clopper, a well-known Greensburg business man, has charge of the road, and he expressed himself as being in every way satisfied with the equipment of the road, which he intimated could not have been better.

The North American Construction Company did the construction work on the Greensburg road.

WESTERN TRADE NOTES.

THE KNAPP ELECTRICAL WORKS are very busy and shipping orders both large and small of Grimshaw, White Core, and other grades of wire right along. They are also doing a brisk trade in their well known annunciators.

MR. MASON, general manager of The Electric Merchandise Co., has returned from his trip to the Buffalo street railway convention perfectly loaded down with orders for electric street railway supplies. Their exhibit in parlor F at the Iroquois Hotel was one of the most popular and interesting, and they added more prestige to their already wide reputation. All classes of their goods are in large demand, and they always take care to carry a stock of the older specialties and devices for roads equipped with the early class of supplies, as well as the latest designs and novelties. This is a feature specially appreciated by roads built some while back, who want some of the parts then used.

FOREE BAIN is in Minneapolis supervising the construction of the electric street railway there, for which he is the consulting electrical engineer. His shop on Market street is pushed to its utmost capacity on repair work, and turning out his now widely known motors and dynamos recently illustrated in our pages. His hot wire and other pattern lightning arresters are also having a ready and active sale.

THE ILLINOIS ELECTRIC MATERIAL CO. report business as elegant with them. Their Murray overhead switch for electric street railways is in especially large demand. Bishop and Canvas Jacket wire are also meeting with usual large success, and giving the best of satisfaction.

MR. THOS. G. GRIER, of the National Engineering Bureau, is actively engaged in making specifications and plans for new electric lighting and power installations, and as consulting electrical and mechanical engineering work.

MR. CRAIGHEAD, recently connected with the firm of Fraser & Chalmers, as electrical engineer, has joined the forces of the Westinghouse Company, with whom he was formerly connected.

THE GREAT WESTERN ELECTRIC SUPPLY COMPANY report continued activity in all departments. Their orders for railbonds, pole-ratchets and curve insulators are in keeping with the spread of electric railways, and their new designs of fixtures are beautifying hundreds of homes. They are also supplying the coming generation with learner's telegraph instruments and with experimental apparatus.

NEW ENGLAND TRADE NOTES.

PETTINGELL-ANDREWS COMPANY have secured the agency for New England and Canada for the Universal Arc Lamp, manufactured by the Universal Arc Lamp Company, of 49 West Twenty-second street, New York. These lamps are intended for use on incandescent direct current circuits, and they can be adjusted for circuits having a pressure of from 100 to 125 volts, using from 8 to 9 amperes. The lamp is also specially adapted for theatrical purposes, taking the place of calcium lights; it can be easily handled and will give all the effects of the calcium.

EDDY ELECTRIC MANUFACTURING COMPANY.—The Spencer Arms Company, at Windsor, Conn., have completed their work and will remove their machinery from the building immediately to make more room for the Eddy Electric Company.

THE WRIGHT ELECTRICAL ENGINEERING COMPANY have installed a 100 light incandescent plant in the factory of the American Circular Loom Company, at Hanover, Mass. The dynamo is of the Mather type, furnished by Frank Ridlon & Co., and will be run by water power. They have also installed a 30 light plant (Tremont dynamo) in the factory of the Smith Improvement Company, Atlantic, Mass., and a 75 light plant (Thomson-Houston dynamo) for Darling Brothers, Worcester, Mass. They are at present wiring the publishing house of Ginn & Co., in Boston, for 75 lights, the current for which will be supplied by the Boston Electric Company. The Wright Company are preparing a slate switchboard for arc, incandescent and motor circuits for the electric light station at Clinton, Mass. This board will take care of two 50 light Schuyler arc dynamos, three 650 light Thomson-Houston alternating dynamos, and one 50 horse power Thomson-Houston 500 volt motor generator. Most of the machine work on the board is being supplied by W. S. Hill, of Boston.

IT is reported, as we go to press, that the Manhattan Elevated Railroad Co. has decided to light its cars by electricity, and will proceed at once to make the necessary arrangements for the work.

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Electrical Engineer.

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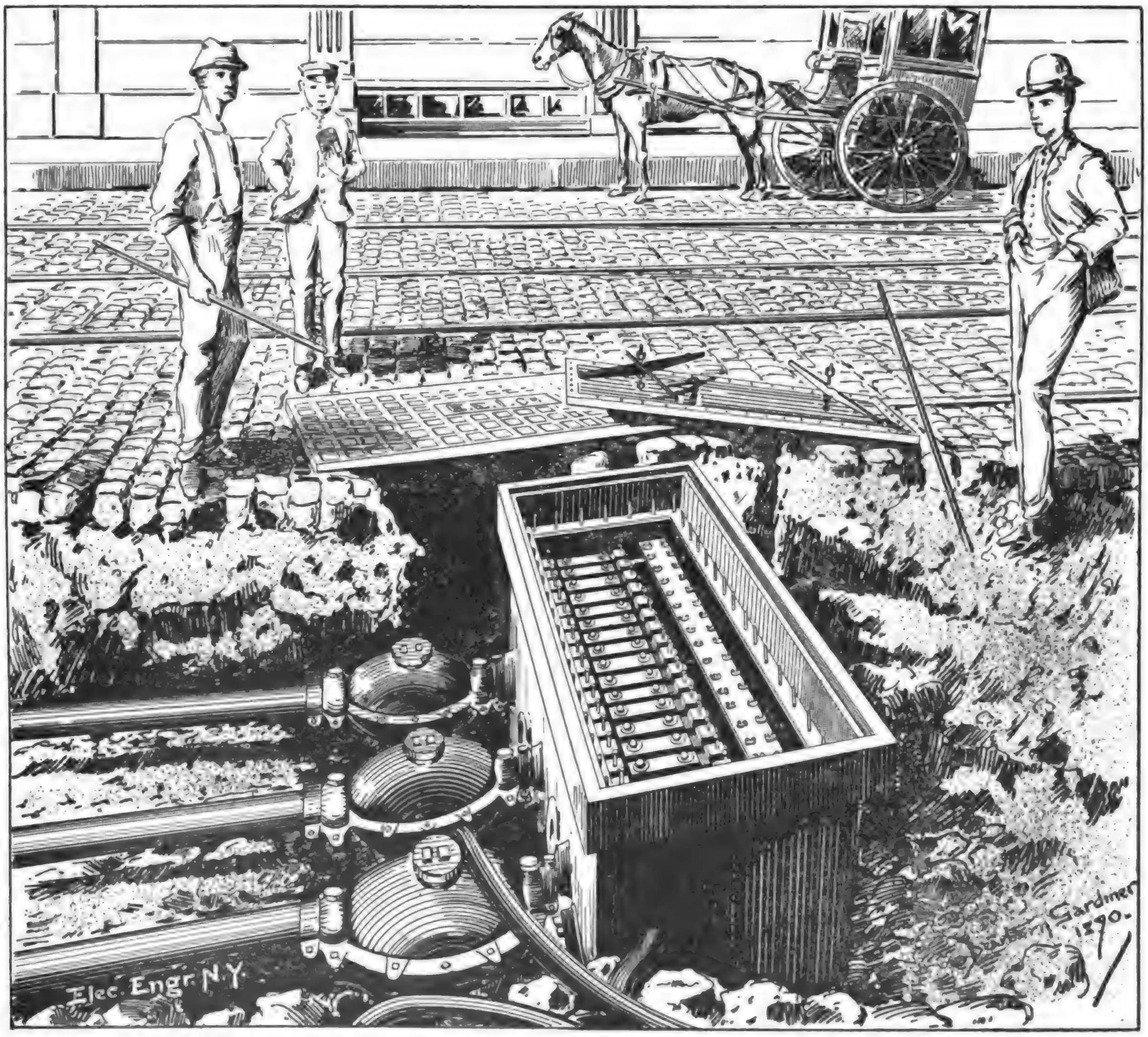
EDISON UNDERGROUND WORK IN BOSTON.

BY A. C. SHAW.

To the outside observer electric lighting in stores, theatres, private residences, etc., is simply a beautiful feature in the progress of illumination, and hardly any thought is ever given to the question of how the current is conveyed from the central station to the scene of lighting. To the electrical engineer, however, this question is a most important one, especially in large cities, where these currents have got to be conveyed underground. The Edison system of underground feeders and mains is well enough known, but there are constantly improvements being made ; and I show in the accompanying engraving a special feeder junction box, which has been designed and put into operation by the Edison Electric Illuminating Co., of Boston. The object of the junction box is to subdivide long feeders into sections of not over 1000 feet in length, so that, should any trouble ever develop on such a feeder, it is not necessary to dig up the streets, and cut the feeder in two, three, four or six parts to locate the trouble. As lighting extends, the feeders become longer and in Boston there are some feeders as long as 6000 feet, and it becomes a serious matter to locate possible trouble. The junction box, as shown, is designed for six feeders, and is made of cast iron, the inside dimensions being 3 feet wide, 5 feet long and 3½ feet deep. There is a projecting ledge in the ordinary manner with screw studs for fastening down the inside cover, which is made water-tight by means of a rubber gasket, and melted wax, in the usual way. As will be seen, there is provision for pressure wires, the small terminals on the right hand side being for that purpose, while copper strips shown on the left hand



Laying Edison Mains in Boston.

side serve to make connections for the feeder. By use of this box, when two or more feeders run through it, when a feeder is faulty it is not necessary to cut out the whole feeder while repairing; the faulty section only is cut out, and flexible insulated cable connections can be used from the upper nuts for short-circuiting the faulty part. The pressure wires are then connected from the junction box instead of the catch boxes at the end of the feeders, and the remainder of the two feeders are used like large mains, the potential being kept constant at the junction box instead of at the catch box. The Edison Co., of Boston, have now six in use, and provision is being made for putting them on all long feeders, different sizes of boxes being used according to the number of feeders in the locality. A few figures regarding the Edison work in Boston, may be found interesting. From the two stations, one in Head Place and the other on Hawkins street, there are now running some 32,000 incandescent lights, about 1400 h. p. in motor service, and about 50 Ward arc lights. The extreme distance covered by the underground system is about two miles and extends from Richmond street in the North End, to West Chester Park in the Back Bay district. The following streets may be taken as bounding the territory covered by Edison tubes, and the streets within that section are thoroughly supplied:—Richmond street, Atlantic avenue, Causeway street, Mount Vernon street, Beacon street, West Chester Park, Boylston street, Berkeley street, Tremont street, Waltham street, Washington street, Kneeland street, Federal street, Atlantic avenue; so that it will be seen that the most important parts of the city and residential quarter are now well provided. In all, there are some 40 miles of underground feeders and mains, the longest feeder being 6000 feet, several of 3750 feet, and the shortest being about 250 feet. The largest feeder used is 750,000 circular mils, solid copper. In crossing the bridges over the railway on Shawmut avenue, specially prepared Clark cable, pulled into three-inch gas pipe, has been used, and a similar method will be adopted for crossing the Concord street bridge to South Boston, an armored Clark submarine cable being used under the drawbridge. In addition to the underground work, the Edison Co., of Boston, have a pole line of 100,000 circular mils with several tie lines, extending from station to station, by way of Atlantic avenue, taking in all the wharves, and supplying power to large numbers of motors used in these busy thoroughfares. When the increase to the station in Head Place is complete, it will be one of the finest and safest of the numerous Edison stations scattered throughout the country.

TWO RECENT "ACCIDENTS."

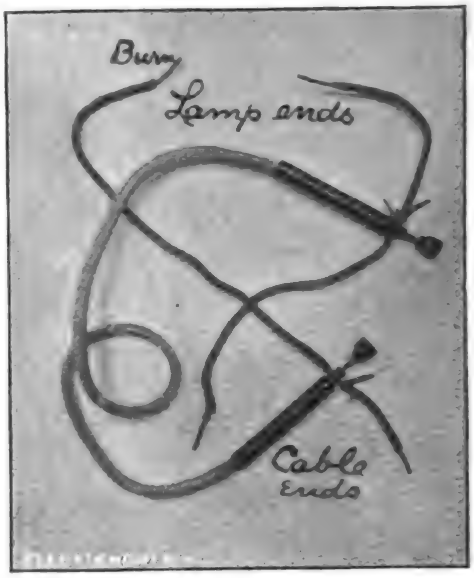
BY DR. S. S. WHEELER.

It may be interesting to the readers of The Electrical Engineer to learn the particulars of two accidents of recent occurrence in New York which have gone the rounds of the press, the circumstances of both of which are rather remarkable.

On the 13th of September the daily papers contained long accounts of a "terrible shock" received by a boy in Pearl street. The subject was thoroughly worked up, the boy and his relatives, his doctor, various policemen, etc., were interviewed by the reporters, and a thrilling account was given of the boy's experience. He was said to have received a "frightful shock," to have had his clothes and body "badly burned," etc. Even the doctor who examined him wrote, in answer to an inquiry, that the boy's coat was burned and in his opinion he "came very near his end."

The city officials ordered a careful investigation. A number of witnesses were found who said they saw a wire fall and knock the boy down, while others said they saw it catch the boy and raise him in the air. Investigation showed that there were no electric light wires in the neighborhood. Further investigation showed that there were no signs of burns on the boy's body or coat, but that the coat had been cut and torn, and bore decided traces of iron rust. The tip of one ear was bruised and there were signs of abrasion under the opposite arm. The wire was found to be an ordinary house top iron wire, and the majority of the evidence showed that it had hung down into the street some time before the boy arrived there.

The great mystery was, How was the boy stunned, what lifted him into the air, and why did it take him several days to recover? Finally a citizen was found whose statement of what he saw was as follows: The end of the wire dropped in the street under the elevated railroad and was carried along about one hundred feet by a passing cab; just as the boy approached the wire a train on the elevated road came up, caught the wire and gave it a sudden heavy jerk, causing its lower loose end to wrap around the boy and lift him about a yard into the air before uncoiling and dropping him in the gutter. The wire tore his coat and the fall stunned him.



Position of Circuits and "Jumper."

Two days after this, and just in time to attract attention and give plausibility to the first case, a patrolman of the Brush Illuminating Co. found one of his lamps out of order while on watch at about 10:45 P. M., in rainy weather. He ascended the pole, which was an ordinary iron one carrying a city lamp supplied by underground wires. The lamp, an uninsulated one, in which the frame forms one pole, was found to be grounded under its hood. The man's subsequent actions show that he decided to disconnect it from the circuit in order to free the circuit of the ground. For this purpose he cut through the insulation of both of the short, well insulated wires, which connected the cable terminals to the binding posts of the lamp, making a bare spot on each about one inch long. He then joined these wires by a well insulated "jumper" or flexible connection wire. Having thus provided a path for the current around the lamp he pulled the ends of the wires out of the lamp binding posts, thereby removing the lamp and the ground from the circuit. Then he touched the exposed end of one of the wires and was killed. He had left his rubber gloves behind, contrary to the rules of the company and the Board of Electrical Control.

Some comment has been made upon the fact that he finished his work before receiving the shock although he had to bare the wires. In removing the insulation from the wires, probably with his penknife, he must have come in contact with the circuit, but did not receive a shock because

the circuit was already grounded at precisely this point through the grounded lamp frame and the iron post. The leakage, therefore, did not pass through his body until he had severed all connections between the line and the lamp. The next time he touched the wires he received the shock.

The photographic view given herewith shows the pieces of connecting wire which had been in use between the cable ends and the lamp, and the insulated flexible jumper which he put on, all in about the position in which they were found on the lamp post. The bits of wire were run cross wise in order to make the polarity of the lamp right without disturbing the cables.

The ragged bits of insulation may be seen sticking out from the wire just as he cut them, and they show that they were cut with a knife. There were slight marks of burning on the upper left hand end of the wire. The circuit consisted of 4½ miles of underground cable, 1½ miles of overhead wire and 48 lamps, of which 37 were on the aerial portion.

Its insulation had been tested one week before with a reflecting galvanometer, and measured 1.6 megohm. It was also tested five days after and measured .9 megohm, both in clear weather. Between these tests there had been a period of very stormy weather, during which no galvanometer tests were made; but it was the duty of the roundsman to try the circuit twice a day with a magneto.

ELECTRIC GYROSCOPES FOR DEMONSTRATING THE EARTH'S ROTATION AND FOR THE CORRECTION OF SHIPS' COMPASSES.

BY G. TROUVÉ.

The instrument for demonstrating the rotation of the earth about its axis consists of an electric motor A, Fig. 1,

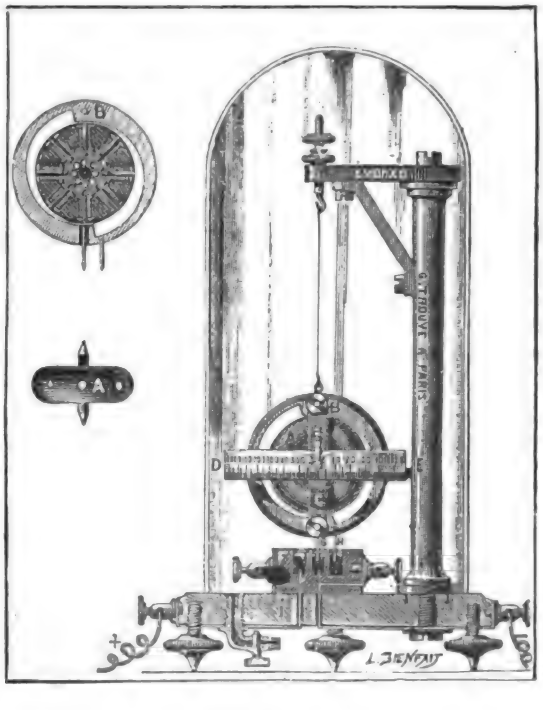


Fig. 1.—Electric Gyroscope for Demonstrating the Earth's Rotation.

which revolves in a vertical plane, on a steel spindle between ruby points. Within the rounded circumference of the motor are fixed eight small electro-magnets. The armature B of iron is of the form shown. To give the rounded surface to the ends of magnets they are first covered, together with the spindle and commutator, with a special cement. This is perfectly balanced and then it is placed in a copper bath where it is left several days until the metal is deposited to a thickness of about 3 millimetres. This is then turned down and the whole balanced again with great care. The motor operated by electricity occupies the centre of a cage formed by the iron armature B and the brass ring C, on which it is pivoted. As it apparently resembles a homogeneous copper disc it gives

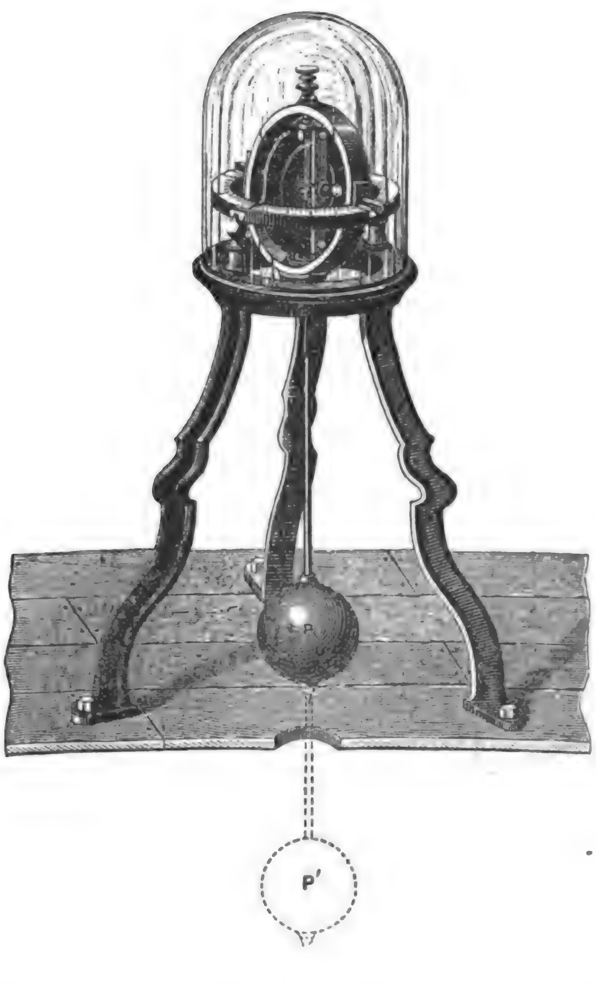


Fig. 2.—Electric Gyroscope for Correcting Ship's Compasses.

rise to surprise when it is seen turning without apparent cause at a speed of 300 to 400 revolutions per second.

The cage and the armature are suspended from a frame by an extensible wire in the centre of a horizontal graduated ring before which a pointer is moved, fixed to the armature B. The latter remains immovable in space, whereas the rotating disc is moved at a high speed. The rotation of the disc may also be ascertained by leveling a microscope on the micrometer scale fixed to the standard E, the divisions of which pass before the pointer.

The current is conducted to the motor by two small platinum points which plunge into mercury cups G and H, one cup being concentric within the other. The whole apparatus it placed within a glass globe which can be exhausted of air in order to remove all external disturbances.

As constructed, the gyroscope acts in a regular manner during the entire time that the current is on; and is thus able to furnish a perfect proof of the movement of the earth and to control it by observation, the displacement being calculable in advance.

To adapt the gyroscope to the correction of ships' compasses, M. Trouvé has constructed an instrument which, while of a heavier construction, still preserves all the advantages of the one just described. He has considered, in effect, that if it is impossible to eliminate entirely the

thousand external causes met with on board ship, they can at least be made negligible with reference to the directing force of inertia by augmenting the latter considerably. For that purpose he has increased the mass, the diameter and the speed of the revolving disc to such proportions that it requires a force of several kilograms to alter the plane of rotation, and so that a strong man cannot suddenly reverse the poles. Under these conditions the disturbing forces exercised are absolutely negligible.

The new instrument consists of the same parts as the one described above, only its form and dimensions have been slightly modified; the turning part of the motor, weighing several kilograms, has in its interior a Gramme ring armature. This ring is placed at the rounded extremity of the disc, the central part of which remains hollow, and has the metallic appearance of the former, which is obtained in the same way as described above. The field magnet is a ring of iron with consequent poles, in which the armature turns concentrically. The field and armature are connected in series. The entire system, instead of being suspended by an inextensible wire, is supported in the centre of a Cardon suspension system by a vertical axis ending in points, which are pivoted in a gate bearings, like the spindle of the motor itself. This Cardon suspension has a long pendulum with a stiff rod fixed to the prolongation of the axis of the system, giving to the whole a perfect vertical position notwithstanding the continuous oscillations of the ship. The slight inclinations to which the apparatus would be subjected are, in fact, reduced in the ratio of the length of the pendulum to the radius of the revolving armature. The pendulum might be prolonged, if desired, even below the level of the base of the instrument.

Constructed in the manner described, neither rolling nor pitching need be feared. It is adapted to correct the compass with certainty, since its axis of rotation remains fixed in space as long as it is necessary to prolong the observation.

STANLEY'S NEW ALTERNATING MOTOR.

The modifications to which the alternating current adapts itself are nowhere better demonstrated than in the variety of alternating motors, which are constantly being brought out. Among the recent work in this direction is a motor designed by Mr. Wm. Stanley, Jr., in which the

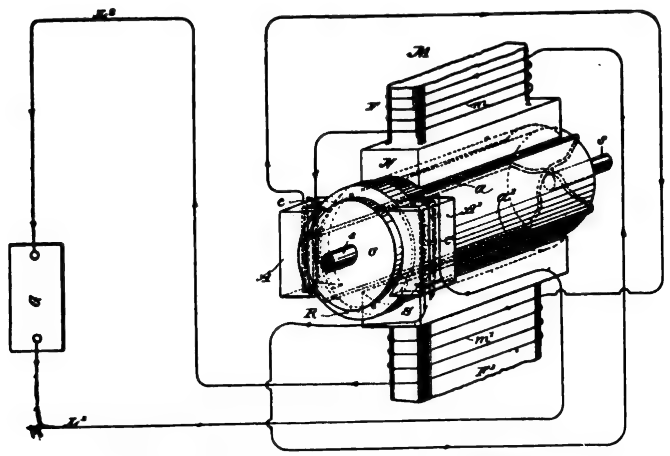


Fig. 1.—Stanley's Alternating Motor.

distinguishing feature consists in the fact that the poles inductively developed in the armature of the motor by means of alternating currents always appear upon a line which occupies a fixed position in space so that a given pole disappears and is succeeded by a pole of the opposite sign, which in turn is followed by a pole of the same sign as before, and so on; the alternations of polarity being synchronous with alternations of polarity in the field magnets of the motor, and the two lines of polarization being so related in position as to produce rotation of the armature.

The accompanying engraving, Fig. 1, shows the general construction of the motor, and Fig. 2 illustrates the circuit connections. As will be seen, the field magnets F F′

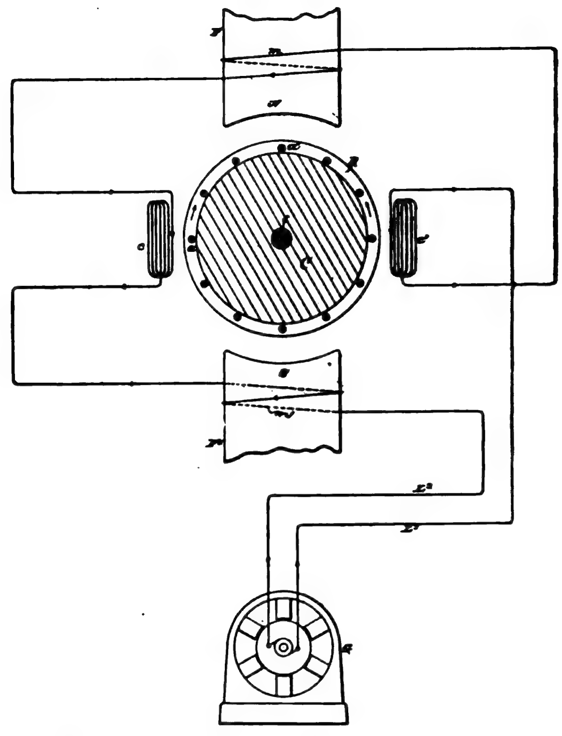


Fig. 2.—Stanley's Alternating Motor—Diagram of Circuits.

of the motor are connected across the mains L′ L². The armature conductors, $a\,a'\,a''$ consist of copper bars extending longitudinally along the armature-core, thence diametrically across the end of the core, and back along the core in a direction parallel to the first course. The terminals of each of the armature-conductors are connected to a conductor R, consisting of a ring or band of copper mounted upon the core and insulated therefrom, as are also the armature-conductors. At diametrically opposite points of the ring R and upon a line approximately at right angles with the magnetic axis of the field-magnets are located iron cores A A′ which partially embrace the ring R. They are wound, respectively, with coils $c\ c'$, which are connected with the mains leading from the generator, either in series with the field-magnet coils $m\ m'$, as shown, or in parallel. The coils $c\ c'$ are wound in such directions that when alternating currents are passed through them the resulting fields of alternating polarity acting upon the ring R will develop opposing electromotive forces, as indicated by the arrows, which, owing to the position of the coils $c\ c'$, will operate to drive current through the ring R towards these armature-conductors; the latter, when the armature is at rest, are not inductively acted upon by the field of force developed by the current in the field-magnet coils.

The method of operation of the apparatus is as follows: Considering the armature in a state of rest, alternating electric currents from the generator traverse the field-magnet coils $m\ m'$ and also the coils $c\ c'$. A line of polarization of alternating polarity is established by the currents flowing in the field-magnet coils, and at the same time alternating currents are inductively developed in those armature-conductors, as a, which occupy positions of inductive effect. The currents thus inductively developed enter the ring R and are carried along the ring to and

through those armature-conductors, as a', which at the moment are not in positions of inductive effect. Thus a second line of polarization is developed in the armature-core, which lies at an angle to the line of polarization due to the current flowing in the field-magnet coils. If current were flowing only in those armature-coils, as a, which occupy positions of inductive effect, the line of polarization established thereby would coincide in position with that due to the current in the field-magnet coils and the armature would remain at rest. The flow of current, however, in those armature-coils, as a', which are not in positions of inductive effect will cause the line of polarization due to the induced currents to lie at an angle with that due to the currents in the field-magnet coils.

The poles in the armature-core will alternate synchronously with those of the field-magnets, and since the armature is subjected to the influence of two lines of polarization lying at an angle with one another rotation will result.

THE NEW THOMSON RECORDING WATTMETER.

The subject of electric meters has always been one that has attracted attention on account of the interest which it has for both those who supply and those who consume electrical energy. Numerous forms of meters have from time to time been devised, each possessing certain advantages and disadvantages.

There was recently published a description of an electric meter invented by Prof. Elihu Thomson, in which an oscillating body moved by the current, and suitably damped, was made to give the required registry of the energy consumed, being, virtually, a wattmeter.

The new meter of Prof. Thomson, which is illustrated in the accompanying engravings, is based upon work done in this field quite a number of years ago by him. In brief, it consists of a peculiarly constructed electric motor which drives a register counting the number of its revolutions, and which also drives a magnetic damper consisting, in

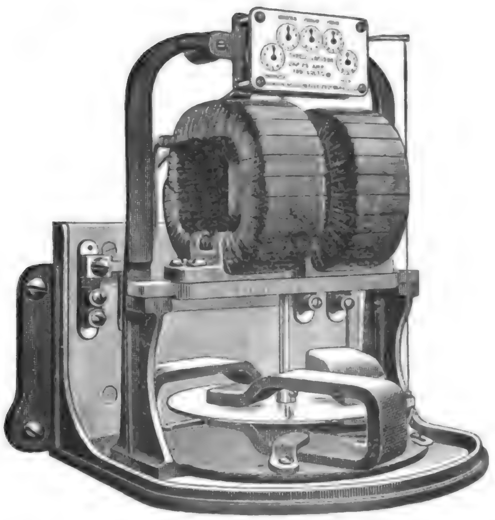


Fig. 1.—The Thomson Recording Wattmeter.

substance, of a closed circuit moved between the poles of three magnets. The magnets generally used are permanent magnets, although it is evident that where continuous currents of constant potential, or constant strength, are obtainable, these magnets may be replaced by electro-magnets.

An interesting fact in connection with this meter, is that it is an energy meter, or wattmeter, and operates equally well with continuous or alternating currents. Its motions are quite positive and almost unaffected by friction. Depending on electric actions throughout, it is said to be not so much affected by temperature and barometric pressures as are meters whose motions are checked by air fans or wings driven in the air.

The new Thomson meter, as made by the Thomson-Houston Electric Company, has a remarkable range in the load it can measure, meters being made having a range of registry from 1 to 200 amperes, the usual range being 1 to 100 amperes. Meters are also constructed to measure currents of as high potential as 500 volts continuous current, and much higher than this, in alternating currents, and

Fig. 2.—The Thomson Recording Wattmeter.

these meters take account of the variations of potential and multiply the potential by the current in measuring the energy. This feature is not essential, of course, as, by supplying a definite strength of current, to take the place of that which is generally taken in derivation to the mains, the instrument becomes one which takes account only of the variations of current. It is exceedingly prompt in its adjustment to variations of load, as is demonstrated by throwing on or off large loads, the effects of momentum being scarcely appreciable.

The meter consists of a vertical shaft resting in a jewelled bearing below, and, guided by an upper bearing, carries on its upper part a hollow frame wound with a set of coils, forming a sort of Siemens' armature of polygonal outline without any iron core. The coils of the armature are attached to a commutator carried on the shaft near its upper bearing, the commutator being made of a little larger diameter than the shaft on which it is placed, and is of special construction both as to material and mounting of its parts. Two light springs bear upon the commutator and constitute the commutator brushes. The armature coils are wound with quite fine wire of many convolutions, and in circuit with the armature is placed a non-inductive resistance, carried in the frame at the back of the meter. The connections of the armature circuit and the resistance in series with it are generally made in shunt, on mains where the potential permits of this being done; or, where the potential is too high for direct action of this kind, a transformer is used to bring it to a desirable potential for use in the armature circuit.

It will be seen that the construction of the armature and the commutator gives a minimum of friction, and the special construction and materials used are found in actual practice to give very good satisfaction. The amount of current which has to be commuted at the commutator is, in any case, quite small. The armature coils or revolving coils have placed adjacent to, and surrounding, them, a set of fixed coils, generally made without iron, through which

coils the main current to be measured passes. They furnish an air field of greater or less strength according to the current flowing in the coils. The field coils and winding, of course, are varied according to the desired capacity of the meter, and sometimes a few turns of a winding in shunt to the mains are placed alongside the main circuit coils to assist the effect on the armature under the lightest loads. An endless screw on the shaft engages with a wheel in the registry train whereby the rotations of the armature are recorded. A variation of the dead resistance in circuit with the armature can, of course, be made the means for the standardization of the readings on the register by increasing or decreasing the armature current flowing under any definite load or current passing in the field-producing coils.

On the lower part of the shaft which bears the armature is mounted a copper disc the plane of which is at right angles to the length of the shaft, and which rotates with the shaft. This copper disc moves between the poles of a number of permanent magnets which are placed so as to embrace it. These magnets are made movable so that their position of action on the disc may be changed with respect to its centre and periphery, whereby the retardation they exert may be modified in such a way as to control the speed of turning of the shaft and its attached parts, under any definite load which the meter is called upon to register. Of course, it is necessary that great care be taken in making

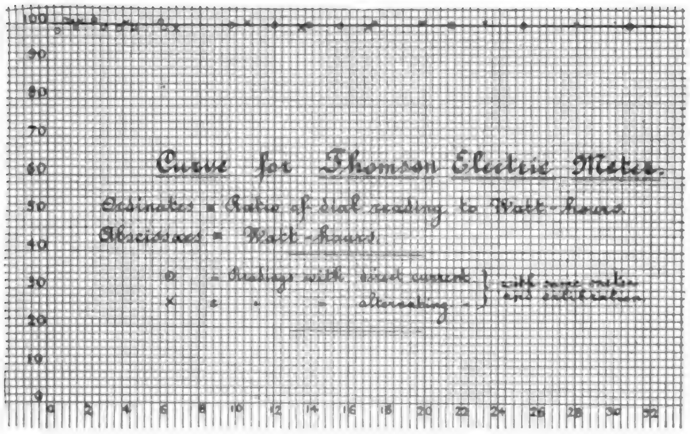


FIG 3.—CURVE SHOWING ACTION OF THOMSON WATTMETER.

the permanent magnets so as to secure permanency of magnetization; the adjustments, however, provided, make it easy to restandardize the instruments at any time.

It will be seen that the commutator of the armature never receives the full potential difference existing between the mains, and that, therefore, there can be no damaging short circuits around it. This is due to the large dead resistance which is in circuit with the armature.

The principle of action, of course, is quite simple. The amount of load or retardation obtained by the copper disc moving in the magnetic field is directly dependent on the speed, and the retarding effect may be said to vanish when the motor stops, and to increase regularly as the speed increases. In like manner the torque or turning force exerted by the armature may be said to vanish when the field current becomes nil, or when there is no load, and to increase regularly under constant potential between the mains as the load of lamps, or other working devices, is increased; that is, as the current passing through the stationary field coils increases. The result of this is that the speed of the meter shaft increases in strict proportion to the load so that the registry is uniform throughout the range, except with the very smallest loads. This will be seen by examining the curve, Fig. 3, obtained from a meter having 25 amperes capacity. This property of the meter is found to be present whether the currents used are alternating or continuous currents. The curve given shows the rate of registration for each load, the verticals indicating the value of the registry for a given current under variations of the total current or total load.

The commutator brushes of the armature are, of course, placed at right angles to the magnetic axis produced by the field coils, and it will be readily understood that an increase or decrease of the current in the armature due to increase or decrease of potential, and of increase or decrease of the field current due to variations of the load put on, or thrown off, together act to vary the speed of the register, and that the meter multiplies the two together and registers the *energy*. The effects of variation of potential may readily be eliminated by causing the magnetization of the magnets which retard the copper disc to depend upon the potential, as when they are made electro-magnets and put in series with the armature; in this case the meter becomes merely responsive to change of current in the field coils, provided, of course, that the retarding magnets are far below the saturation point.

It will also be readily seen that from the relative disposition of the armature and the field, the current returning from the work, as in case of a storage battery, discharges reversely through the meter and results in the reduction of the registration by the meter moving backward; and in a similar manner energy restored by alternating currents due to displacement of phase by self-induction is also deducted and credited by the meter as returned energy. Hence if the meter were used to register on a circuit of alternating currents feeding lamps, the current and potential might be the same as when alternating currents were feeding an inductive resistance, such as self-induction coils, and the current traversing the field coil of the meter, and also that traversing the armature circuit might be the same under these conditions. But the registration of the energy consumed would be much larger in a given time in the case of the lamps, than in the case of the self-inductive coils used as a load.

A ROUGH TEST OF TRANSFORMER EFFICIENCY.[1]

MANY engineers in charge of central stations want a rough method of arriving at the efficiency of a transformer in the case of closed iron circuits. This may easily be carried out with the help of a resistance box, and an alternating current ammeter and voltmeter, which are always available in stations. The primary current when the secondary is open is measured. This is multiplied by the primary pressure, and the product is divided by 2 to give the loss in the iron. The loss in the copper at any load is then calculated by C^2R in the primary and secondary. For instance, suppose a 500 watt transformer for 2,000 and 100 volts takes, with the secondary open, 0.073 ampere. The iron loss is $0.073 \times 2{,}000 \times \frac{1}{2} = 73$ watts. If the primary and secondary resistances are [illegible]8 and 0.16 ohm, respectively, the full load losses by copper are [illegible].5 watts. The total loss is then 82.5 watts at full load, giving an efficiency of 85.9 per cent. The measured efficiency of this transformer, according to Prof. Ryan, was 86.3 per cent. This rough method probably gives the loss in iron well within 10 per cent.; that is to say, gives the efficiency within 1 per cent. It is probably more accurate than calorimeter experiments or calculations from clock-face diagrams. To get the "all-day efficiency" the iron loss is taken as constant. For instance, if the transformer has an average load equal to four hours' full load per day, the iron loss is taken as $73 \times 6 = 438$ watts, and the copper at an outside value of 5 watts. This gives an all-day efficiency of 53 per cent. This is low, but then the transformer is very small, and of an old form.

1. *Industries.*

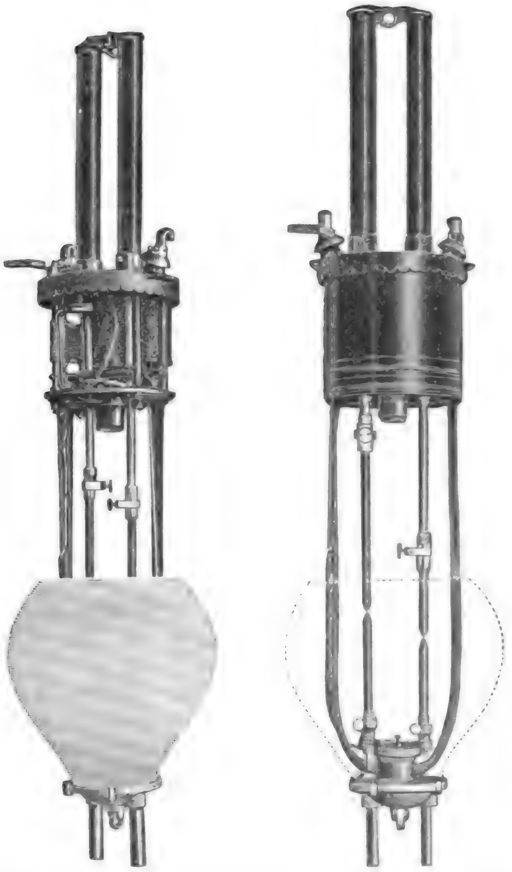
THE NEW BRUSH-ADAMS ARC LAMP.

The experience which has been gained during past years with arc lamps under the disturbing influences to which they are subjected out-doors has led to the construction of a new lamp, in which advantage has been taken of the many lessons taught by the "troubles" of the past.

This lamp, known by the name of the Brush-Adams lamp, has just been put out for general use by the Brush Electric Co., of Cleveland, and as it embodies numerous excellent features will prove interesting to many of our readers.

To begin with, all springs that can in any way influence the arc have been abolished, and thus the chief cause of uneven and changing adjustments is at once eliminated, while at the same time the use of glycerine, oil or mercury is entirely avoided. The frame of the lamp is thoroughly insulated from the working parts, and unless a hanger-board is desired no hood need be used, as the lamp is weather-proof. The hanger-boards, globes, jackets, rod protectors, etc., are all alike for single and double lamps, and a large saving is thus made to lighting companies in the stock of spare parts required to be kept on hand.

The accompanying engravings show the method of securing the globe upon the lamp. This method effectually prevents the blowing off of globes or breakage from heating or drops of melted copper from the carbons. As will be seen, no thumbscrews, which frequently crack the globes, or drop out and loosen them, are used, and it is claimed that the flaming arcs which sometimes occur when the lamps are about to cut out, cannot possibly cause breakage



Figs. 1 and 2.—The New Brush-Adams Arc Lamp.

of globes. Another important feature, which will be readily appreciated, especially in "hot trimming," is the ease and rapidity with which the globe can be removed and placed out of the way, as shown in Fig. 3. The careless trimmer who might wish to delay the cleaning of the globe cannot be troubled by sleet or dust sticking to the globe-holder.

The Brush-Adams lamp is adjusted to a standard current and voltage and no means of changing this adjustment is provided. The current required is stamped upon the lamp, and with this current the manufacturers claim that it will burn with perfect steadiness and reliability on any circuit. Lighting companies and the public suffer much

Fig. 3.—The New Brush-Adams Arc Lamp.

from re-adjustments made by careless and incompetent employés. The adjustments of the new lamp need never be changed, or, if required to be altered for a different current, must be changed with special but inexpensive tools provided by the manufacturers.

Cleanliness of arc lamps is necessary for perfect working, but is often neglected in dusty or smoky locations on account of the difficulty of cleaning, involving in the old forms the taking down, and apart, of the lamp. The Brush-Adams lamp is so constructed that while the lamp is in its ordinary burning position in the street or elsewhere, the rods, clutches and other parts requiring cleaning can be slipped out quickly and put back without any soldering or other work.

Another feature is the arrangement of carbon rods and clutches, which are shown separate in Fig. 3. The clutches are claimed to be as durable as any other part of the lamp, and the rods do not require to have the true round surface usually necessary, as the bearing surface of the self-cleaning clutches will feed a rod pitted or scarred or worn. The cut-out is positive and sure, with no liability to burn out, and a very effectual device is provided for preventing the "lapping" of carbons and for insuring the lighting of the

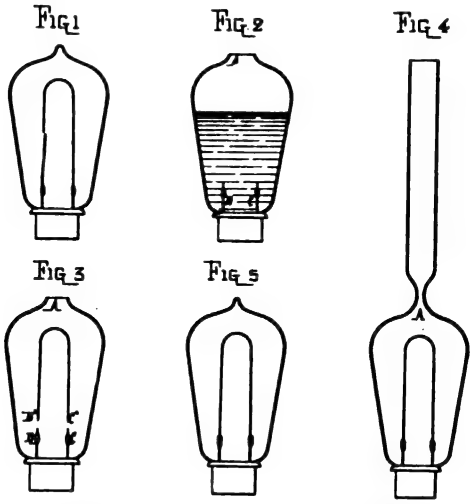
lamps whether trimmed with the carbons apart or in contact.

The exterior finish of the standard lamp is black japan with bronze trimmings, the idea being that the user can bronze or ornament this surface for special purposes if necessary. The bright brass lacquered finish of many lamps, while showy when new, is difficult and expensive to renew.

The hangerboards, alike for single or double, indoor or outdoor lamps, are provided with a switch very strongly made, arranged to close one circuit before the other is opened, so as to prevent arcing, and to cut the lamp entirely out of circuit when switched off.

PAUTHONIER'S METHOD OF RENEWING INCANDESCENT LAMPS.

Ever since the present type of incandescent lamp became an article of regular manufacture, attempts have been made to overcome the necessity now existing, of discarding practically the entire lamp when but a single element, the filament, is ruptured or destroyed. Some method by which a new filament can be introduced leaving the remaining solid parts of the lamp intact will therefore be conceded to be of considerable value. To accomplish this object, M. Casimir Pauthonier, of Paris, a few years ago devised a simple process which has been in operation



Pauthonier's Method of Renewing Incandescent Filaments.

abroad, and which has been recently patented in this country. For this purpose the broken filament is withdrawn from the lamp, the tip A, Fig. 2, having been previously opened. There are thus only left two short stubs of the old carbon which act as primers to the soldering at B and C. The lamp is then filled with a hydrocarburet, and a new filament introduced into the bulb, the ends of which are brought opposite the stubs, as in Fig. 3. The carbon is held in this position by a thread of copper attached to a frame, the arm of which may be raised or lowered, as required. The ends are brought to the stubs B and C by means of a small plier, the head of which is connected by a flexible conductor to a source of current. By passing a current first through one leg of the filament to the juxtaposed stub, and then through the other, carbon is deposited at the joint and the ends firmly supported, thus furnishing the lamp with a new filament. Fig. 4 shows the latter ready for exhaustion, and Fig. 5 the completed lamp. We may add that it is proposed to introduce the process in this country.

A MUSEUM ON A TRAIN.

At the shops of the St. Charles Car Co. there have recently been built four gorgeous museum cars. The gilding alone cost over $3,000 and the cost of the entire coaches is about $24,000. The idea is to run the train into a town and have the exhibition on the cars. One car contains the electric light plant which is to light the museum train.

BRADLEY'S ALTERNATING MOTOR.

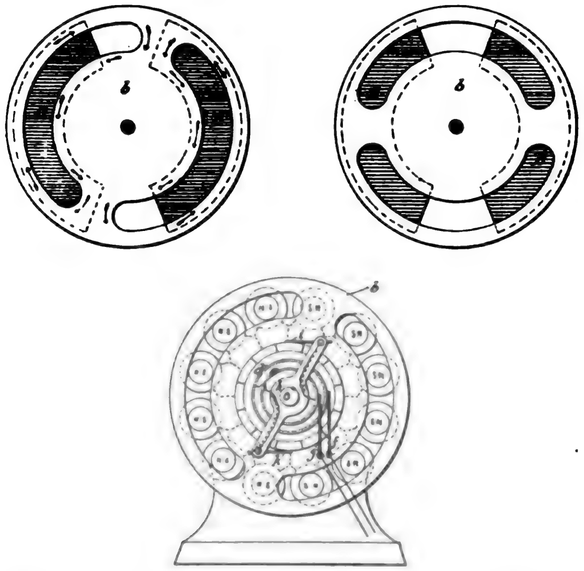
For some time past Mr. Charles S. Bradley, whose multipolar continuous current dynamo will be known to many of our readers, has devoted considerable attention to alternating current motors and as a result has worked out a number of types possessing considerable originality. Among these is one in which a single current field magnet is employed, influencing an armature carrying closed induced circuits and having a commutating device for shifting the neutral point in the field magnet and producing a progressive torque.

To explain the action of the motor we may take, for example, a disc *b* having two circumferential slots, as in Figs. 1 and 2, and set it so that each slot surrounds or threads the lines of force from alternate fields A and B; the disc becomes thus the seat of induced or secondary currents when the field-magnets are energized by an alternating current, the paths of such currents being approximately indicated by small arrows on the disc, which constitutes two closed circuits. If the disc be placed in the relation shown in Fig. 1, as soon as the alternating current is admitted to the field A B the rise and fall of potential therein sets up induced currents, and motion of the disc results from the following principles: All the lines of force momentarily produced during one phase of alternation of magnetism in the field-poles cause momentary induced currents, as indicated by the arrows. These currents pass from the centre to rim and rim to centre of the disc at the two unslotted portions shown, being from centre to rim at one and from rim to centre at the other at the same instant; and therefore the currents generated by A and by B have common directions through the unslotted portions, and are therefore attracted one by the nearest part of field A; and the other by the nearest part of field B; and as these attractions take place at opposite sides of the shaft or centre, motion of the disc necessarily results. This motion continues in one direction till the disc is about in the position shown at Fig. 2. Motion then ceases, because the closed circuits of the disc are equally attracted by the oppositely-induced field-magnets, which neutralize each other. Thus continuous rotation can be effected by subdividing and angularly displacing or commutating the field-magnets.

One way in which the principle has been carried out in practice by Mr. Bradley is shown in the accompanying engraving, Fig. 3. Here a disc *b* is fixed on a shaft having the two insulated rings *d e*, on which bear the brushes *f g*. The shaft has fixed to it the brush-arm *h*, which in turn carries at diametrically-opposite points the insulated brushes *i k*. These brushes bear on a stationary segmental commutator C, having its blocks looped in successively to the subdivided field-circuit, so as to shift the polar line of the latter accordingly. The field-magnet is composed of a group of cores arranged in a circular series, each provided with its own coil, and the pole-pieces facing the path of the semicircular slot in the disc *b*. Fig. 3 shows a series of field-magnets facing one side of the disc only; but it is preferable to have two series of such field-magnets facing each other and so wound that at any instant at which a given pole has north polarity the pole-piece opposite it on the other side of the disc has south polarity, and so on, so that the lines of force pass directly from the pole-piece of one series to the pole-piece of the opposite series of field-magnets. The entire annular series of field-magnets have their coils connected in series similarly to the connections of a Gramme ring, so as to form a closed circuit, and between each coil and the next adjoining one a loop is taken and connected to the corresponding plate of the commutator C, which is supported in a stationary position so as to always preserve the same angular relations with the field-magnets.

Obviously the line-current passing in at the brush *f* to ring *d* would go through brush *k* into the commutator, and then dividing, one half would pass around the magnet-coils

on the right of the vertical line and the other half around the magnet-coils on the left of the vertical line, and at the top both currents join together at the commutator and pass out at the brush *i* through ring *e* into brush *g* and thence to line. Consequently at any given moment all the field-poles on one side of the vertical line will have one polarity and all those on the other side of the vertical line the opposite polarity. Thus, in the position shown in Fig. 3, the neutral line will be a vertical line drawn through the figure, and this line will be the line of commutation and correspond with the operating position of the brushes *i k*. The disc *b* being already advanced a little toward the right, so as to correspond with Fig. 1, immediately takes up motion due to the preponderating attraction, as already explained, and this motion continues with a powerful torque until the brushes have reached the next segment of the commutator, whereupon the neutral line is immediately shifted to the right and the position of maximum torque is again obtained, causing a further attraction of the disc *b* in the same direction, and the corresponding movement of the brushes *i k* repeats this indefinitely as the disc rotates, owing to the commutation of the field-magnets, so as to



Figs. 1, 2 and 3.—The Bradley Alternating Motor.

keep the position of maximum torque continuously ahead of the actual position of the disc.

In Fig. 4 is illustrated a form of motor wherein the disc *b* rotates between the adjacent ends of two circular series of field-magnet poles, as already alluded to. In this form of machine the field-magnets are commutated, as before, and the opposite pole-pieces will at any one instant be always of opposite polarity, so that the lines of force between the two will pass through the rotating disc *b*. Laminated cores are employed for the field-magnets and their back ends joined by means of laminated yokes.

Instead, however, of connecting the members of the field-magnet and commutating them, as shown in Fig. 3, the arrangement shown in the diagram, Fig. 5, has been adopted. On the shaft, and rotating with it, are placed the insulated rings *d* and *e*, as before, and on these brushes bear and convey the line-currents to the commutator. There are also fixed on the shaft the two semicircular commutator-plates 1 and 2, plate 1 being connected to ring *d* and plate 2 being connected to ring *e*. Surrounding the commutator is a ring 3 carrying at points corresponding to the angular displacement of the several field-magnets the brushes 4, 5, 6, 7, 8, 9, 10 and 11. The plates 1 and 2 at their adjoining ends are separated from each other by a gap at least equal in width to that of one of the brushes, as shown in Fig. 5. These respective brushes are connected to the corresponding ends of the field-magnet coils, 12, 13, 14, 15, 16, 17, 18 and 19. The other or outer terminals of all the field-magnet coils have a common connection in the circle *m*, which is obviously the same as if all the outer terminals of the coils were connected together at one point.

Suppose, now, an impulse of current arrives from the

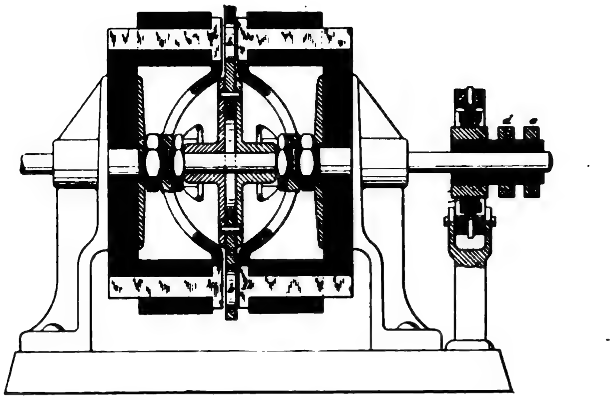


Fig. 4.—The Bradley Alternating Motor.

line to the ring *d*. It passes thence to the plate 1, from it through the three brushes 8, 9 10, and divides in parallel circuit through the three field-magnets 16, 17, 18, joining together at the common connection and passing into the field-magnets 12, 13, 14, thence through the brushes 4, 5, 6, thence to the plate 2, ring *e*, and back to line.

It will thus be observed that field-magnet coils 19 and 15 are open-circuited. As the commutator 1 and 2 rotates, field-magnets 12 and 16 become open-circuited, and in the further rotation of the armature and commutator each diametrically-opposite set of coils becomes open-circuited, while the set of coils on each side of that line respectively contribute opposite polarities to the circular range of field-magnet poles and the commutation proceeds with the same effect as in Fig. 3, but with the additional advantage that the short-circuiting effect which would take place in the form shown at Fig. 3 with the brushes connected to ad-

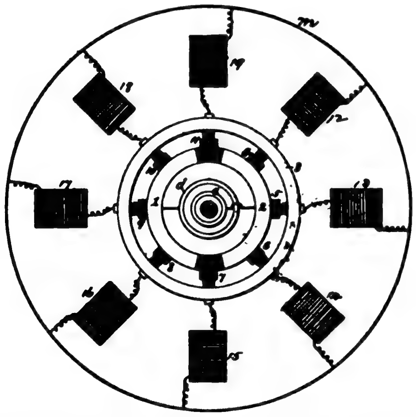


Fig. 5.—The Bradley Alternating Motor.

joining plates of the commutator is totally absent, and consequently the damaging sparking is entirely eliminated.

MOTORMEN AT THIRTY CENTS PER DAY.

A drunken motorman, whose salary was less than thirty cents per day, caused an accident at Fiesole, Italy, which resulted in fatal injuries to several passengers, and so prejudiced the public there against the road that it will be years before it can be worked without loss. A company that hires an ignorant man at thirty cents a day to fill so important a position not only should be forced out of existence, but should be held strictly accountable for the damage that resulted from its misdirected economy.—*Boston Transcript.*

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GEO. M. PHELPS, President. F. R. COLVIN, Treas and Business Manager.
Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
New England Editor and Manager, A. C. SHAW, Room 70—690 Atlantic Avenue, Boston, Mass.
Western Manager, W. F. COLLINS, Temple Court, 225 Dearborn Street, Chicago, Ill.

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Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers*

VOL. X. NEW YORK, NOVEMBER 5, 1890. No. 131

It is not derogatory to the dignity of Mathematics to approach the subject by means of a pair of compasses or a foot-rule or a metre-scale, instead of the stately process of proposition-lemmas and corollaries ending by Q. E. D.—John Trowbridge.

LIGHTING THE NEW YORK ELEVATED TRAINS.

BRIEF mention was made in our last issue of the intention of the Manhattan Elevated Railway Company to light its trains by electricity. The report to which we gave publicity is well founded. The company has been seriously considering the matter and, in fact, is said to have gone so far as to have secured preliminary estimates upon no fewer than 216 individual outfits. This, of course, would imply an intention to equip each train with a plant of its own, the dynamo and engine being placed either upon, or in close juxtaposition to, the steam locomotive. If we take the train to consist of five cars, each with a dozen lamps, and allow as many more for the locomotive cab, tender, headlights and taillights, we have a total of 72 lamps of 16 c. p., or a requirement of, say, 7 to 8 h. p. of engine and dynamo on each train. Smaller lamps could be used with satisfactory results, but the figures above will serve. Such an equipment of 216 plants would therefore represent in the neighborhood of 1,500 h. p. of dynamos and engine capacity in the small units named.

It is gratifying to know that a change of this kind is imminent. The lighting of the elevated trains has long been unsatisfactory, and what with breakage, cleaning, oil, attendance, &c., must be expensive. It is the common experience to travel in poorly lit cars. Not infrequently one sees passengers endeavoring to improve matters by either raising or lowering the flame; and very often the lamp chimneys burst, scattering hot, greasy glass over everybody. The lamps are badly placed, and it is difficult to assume any position near them or under them so as to secure the full benefit of their obscure rays.

It seems to us, however, that the matter for consideration is more than merely one of lighting the trains. There are all the stations to be taken into account, and they need better light fully as much as the cars do. With this element brought in, the problem takes a different shape, and the desideratum, apparently, is a system that shall at one and the same time light both the stations and the trains. The resort to 216 distinct plants would imply train lighting alone, by direct service, maintained only as long as the dynamo and its special engine are running. But, with an agency so flexible in its application as electricity, there are several ways of gaining the end sought. At the present moment, for example, a movement is on foot for the establishment of special cars for smokers. If this were granted, it would evidently be easy to concentrate in such cars, at one end, all the auxiliary apparatus for heating and lighting without any drain on the locomotive for steam except in the extra haulage. Here storage batteries could come into play, a very small plant charging throughout the day, and the lamps drawing a large part of their current from the batteries in the evening. This plan, however, still leaves the stations and track signals unprovided for, and suggests another, by which current supply plants, being placed advantageously along each line, each track could be wired up so that the circuits to the stations would run on the elevated structure and the trains would pick up their current by the simplest kind of contact devices.

If the whole road were operated by electricity, as it should be, the lighting problem would be swallowed up in the settlement of much larger ones, and would be no more heard of. On large numbers of street electric railways, the cars to-day derive the current for all their lights direct from the motor circuits. No better place than the New York elevated roads could be asked for the application of such methods. Yet it begins to look as if Boston and Chicago would have their elevated electric roads before New York, although the time is so ripe here for the new departure. Steam transit in cities is an anachronism and a nuisance, despite its enormous benefits, and we believe steam locomotives will disappear from the elevated tracks almost as soon as the horses do from the surface roads. This may not be in the immediate future of next week, but it is coming as surely as to-morrow's sun. The 250 American cities enjoying electric rapid transit set an example that even the stolid conservatism of New York cannot resist.

ELECTRICAL ACCIDENTS.

OUR readers need hardly be told that the alleged dangers of electricity which the daily press delights in bringing to the attention of the awe-stricken public are largely drawn from the imagination, and that little, if any, trouble is taken to go to the bottom and determine the true causes of such accidents. We think Dr. Wheeler has, therefore, done a public service in presenting what is undoubtedly a correct explanation of the causes which led to the death of a lineman in this city. Leaving out of consideration the non-observance on the part of the lineman of the strict rule regarding the wearing of rubber gloves, and which, if followed, would certainly have prevented the accident, the

condition of the circuits, as evidenced by the photographic reproduction in another column, are evidence that the unfortunate man did not exercise sufficient care in the handling of the connecting wires. It seems strange indeed that men who ought to be, and no doubt are, well aware of the character of their work and the precautions necessary to prevent accident, should invite disaster by what cannot be characterized as anything else but sheer carelessness. It may be true, as has been assumed, that rubber gloves may not be the most convenient things to work with, but where the question involved is one in which the whole electric light industry is interested, as well as the safety of the employé, the rule ought to be strictly enforced. The explanation of the injury done in another case of an alleged electrical accident would be ludicrous, but for the fact that it shows the unnecessarily alarmed state of the public mind, and the proneness to ascribe to the current an innate viciousness which it does not possess.

THE DETERMINATION OF SELF-INDUCTION.

THE construction of alternating current apparatus in its various forms now occupies so largely the attention of electrical engineers that those who are engaged in this class of work, together with those who are about to undertake similar pursuits, will be interested in the admirable article by Mr. C. Steinmetz which is concluded in this week's issue. The apparent difficulties with which exact determinations of this nature are accompanied are largely due to the necessity of employing apparatus requiring some skill and training for their management; but in the majority of cases a fair approximation is quite sufficient for practical purposes. It is with this in view that Mr. Steinmetz describes some methods for determining the self-induction of electric circuits requiring the use of instruments with which all practical electrical engineers are familiar. An intelligent application of these methods may save much time and expense, and as an exercise for the student a simple series of tests with apparatus usually at hand, will go far towards inculcating sound ideas as to the nature and effects of self-induction.

THE STANLEY ALTERNATING ARC MACHINE.

THE description of the Stanley alternating arc dynamo, which first appeared in our columns about six months ago, at once attracted attention to the machine as one possessing remarkable characteristics and the study of which would, no doubt, as we at that time suggested, be taken up in the near future. The results which have been detailed by Messrs. Tobey and Walbridge in their paper read before the American Institute of Electrical Engineers certainly confirm the claims made for the remarkable regulating power of this machine and bring out a number of peculiarities which are worthy of attention. Probably the most characteristic action of the machine is that exhibited by the form which the curve of E. M. F. assumes, approaching with increasing load almost to the form of a reversed pulsating current instead of the sinusoid of the incandescent machine. Evidently such a curve is due to the enormous self-inductive properties of the machine, in virtue of which naturally all the actions observed are due. It is not uninteresting also to note the reactive effect of the main current in this machine upon the exciting current. Although the latter is generated from independent coils, it nevertheless is subjected to the influence of the armature poles and partakes of the wavy motion, its strength varying over considerable range with each pulsation of the main current. In Mr. Thorburn Reid's paper the result of analysis bears out the results found in practice and affords a means which may guide others in the predetermination of similar machines. While the test of Messrs. Tobey and Walbridge extended over the full range of the capacity of the dynamo, even at a short circuit, it would have been interesting, we believe, to have obtained the data resulting from the machine when run on open circuit. Naturally a varying difference of potential would have been generated at the terminals, the magnitude of which would have been interesting to determine.

The New Thomson Alternating Meter.

RECOGNIZING the value of a simple and reliable device for measuring current, Professor Elihu Thomson has in the past devoted not a little attention to the design of various meters, among which probably those of the oscillating type, in which a volatile liquid is employed as the moving force, as it were, are best known. Recently, however, Prof. Thomson has devoted particular attention to the construction of a meter which shall be adapted to both continuous and alternating currents and at the same time indicate not only the consumption of current, but give it in the value of the pressure on the mains; in other words, a power or wattmeter. The manner in which Prof. Thomson has worked out this problem is highly ingenious and is evidently based on simple principles. The problem to be solved evidently was to construct a motor in which both the pressure and the current should be the factors determining the speed and a device embodying a retarding force which should vary in the direct ratio with the speed of the machine. The relative disposition of field and armature of the motor and their connection with the working circuits fulfills the former conditions, while the disposition of the copper disc retarded by the encircling magnets fulfills the second. With constancy of magnetism assured in the permanent magnets and friction reduced to a minimum, as it appears to be in this instrument, its accuracy ought to be very high. Not the least interesting point in connection with it is the quality it possesses, as exhibited by the curve, of affording practically uniform readings for both continuous and alternating currents.

Electrical Work at the World's Fair.

SEVERAL weeks ago, the use of electric power on a large scale to run the World's Fair was discussed by us at some length. Mr. Gardiner C. Sims, Commissioner from Rhode Island and Chairman of the Electrical Committee, has now formulated his ideas on this subject in an admirable communication to the Executive Committee of the National Commission. He proposes not only the use of motors to drive exhibits, but the operation of elevated electric railways between the sections of the Fair, and special novelties, such as the electrical repairing of ship's hulls afloat, and the like. As we have said already, the scheme recommends itself at once to the approval of every electrical engineer in the country, and we hope to see it carried out.

SOME PRACTICAL METHODS FOR THE DETERMINATION OF INDUCTIVE RESISTANCES AND SELF-INDUCTION OF ALTERNATE-CURRENT INSTRUMENTS.—II.

BY CHAS. STEINMETZ.

B.—DETERMINATION OF THE SELF-INDUCTION OF MEASURING INSTRUMENTS.

The static electrometer is considered the best instrument for measuring alternate current potentials. But, unfortunately, this delicate instrument is hardly adapted for practical use in the factory. The calorimetric instruments, as, for instance, the Cardew voltmeter, can also be highly recommended.

But for direct measurement of the strength of alternating currents, hardly any other instrument can be relied upon but the electro-dynamometer, although its self-induction has to be considered sometimes, as shown in Part I. If we make the necessary corrections for self-induction, the electro-dynamometer can also very well be used as a voltmeter.

The main condition for all electro-dynamic alternate-current instruments is, that their magnetic field always corresponds to the instantaneous strength of the current, so that for the same current the magnetism is the same, no matter whether the current is increasing or decreasing. This condition excludes all instruments containing iron, and also such instruments in which eddy-currents can be set up.

Seeing the difficulty of securing practical alternate current instruments without self-induction, we have to find methods to determine the amount of this self-induction and the corrections necessitated by it. In measuring the strength of currents only, by the electro-dynamometer-ammeter, self-induction has no influence; but its determination becomes necessary where these readings are to be used for calculations of resistance, self-induction, power and so on.

To determine the self-induction of an alternate-current instrument, a very reliable way is, after having tested the instrument by continuous currents, so that it can be used as an ammeter, giving the effective current flowing through it, to proceed as follows:—

1. Connect it, together with an additional non-inductive resistance, if necessary, in parallel with a current-indicator. For this any instrument can be used, which for the same effective current always gives the same reading, no matter whether this reading is right or wrong; therefore, most of the non-polarized continuous-current instruments can be used.

Let the electric resistance of the instrument proper $= r$.
Let the additional bifilar resistance $= r_0$.
Let the alternating current flowing through the instrument, and read by it as an ammeter $= c_1$.
Let the reading of the current-indicator in the shunt-circuit $= v$.

2. Connect the instrument r with its additional resistance r_0 in series with a bifilar resistance R and in parallel with the same current indicator, and vary the alternating current so that the current-indicator gives again the same reading v, thereby showing that the shunt-current, and therefore the potential-difference at the terminals of the branch-circuit containing the instrument, is again the same as in connection (1).

Then let the alternate current flowing through the instrument $= c_2$.

Now, in the first connection (1), the electromotive force consumed by overcoming the electric resistance, is

$$e_1 = (r + r_0)\, c_1.$$

The E. M. F. due to self-induction:

$$e_1' = \frac{2\pi X}{T}\, c_1;$$

where X is the coefficient of self-induction of the instrument, and T the period.

Therefore, the resulting or impressed E. M. F., according to the parallelogram law, is:—

$$\sqrt{e_1^2 + e_1'^2} = c_1 \sqrt{(r + r_0)^2 + \frac{4\pi^2 X^2}{T^2}}$$

In the same way, the resulting or impressed E. M. F. with the second connection (2) is found:—

$$\sqrt{e_2^2 + e_2'^2} = c_2 \sqrt{(r + r_0 + R)^2 + \frac{4\pi^2 X^2}{T^2}};$$

and, both being equal, because of the shunt current being the same:—

$$c_1 \sqrt{(r + r_0)^2 + \frac{4\pi^2 X^2}{T^2}} = c_2 \sqrt{(r + r_0 + R)^2 + \frac{4\pi^2 X^2}{T^2}} \qquad (9)$$

and therefrom we get:—

$$X = \frac{T}{2\pi}\sqrt{\frac{c_2^2 (r + r_0 + R)^2 - c_1^2 (r + r_0)^2}{c_1^2 - c_2^2}}\,; \qquad (10)$$

and the shifting of phase, that is, the difference of phase between current and terminal pressure of the instrument:

$$\tan\omega = \sqrt{\frac{c_2^2\left(1 + \frac{r_0 + R}{r}\right)^2 - c_1^2\left(1 + \frac{r_0}{r}\right)^2}{c_1^2 - c_2^2}} \qquad (11)$$

Now in making several readings with continuous currents, we can eliminate the resistances r_0 and R, also. In connecting the instrument in a continuous-current circuit in series with r_0, with R, and with both $r_0 + R$ and varying the current so that the current indicator in the shunt gives the same reading v_0; or, interpolating for this reading v_0, we may get the three currents:

c_3 through r_0 and the instrument r.
c_4 through $r_0 + R$ and the instrument r.
c_5 through R and the instrument r.

Then we have:—

$$c_3 (r + r_0) = c_4 (r + r_0 + R) = c_5 (r + R); \qquad (12)$$

and therefrom:

$$\left.\begin{aligned} r_0 &= \frac{r\, c_3 (c_5 - c_4)}{c_4 c_5 + c_3 c_4 - c_3 c_5} \\ R &= \frac{r\, c_5 (c_3 - c_4)}{c_4 c_5 + c_3 c_4 - c_3 c_5} \end{aligned}\right\} \qquad (13)$$

Substituting this in formula (10) and (11):—

$$X = \frac{r\,T}{2\pi} \cdot \frac{c_5}{c_4 c_5 + c_3 c_4 - c_3 c_5}\sqrt{\frac{c_3^2 c_2^2 - c_1^2 c_4^2}{c_1^2 - c_2^2}} \qquad (14)$$

$$\tan\omega = \frac{c_5}{c_4 c_5 + c_3 c_4 - c_3 c_5}\sqrt{\frac{c_3^2 c_2^2 - c_1^2 c_4^2}{c_1^2 - c_2^2}} \qquad (15)$$

Now, when we can attribute to the additional resistance r_0 a particular value, for instance make it $= 0$, or $= R$, we shall save one of the continuous current readings and formulas (14) and (15) become simpler.

(A.) Without additional resistance, for instance: $r_0 = 0$. Therefore: $c_5 = c_4$.

$$X = \frac{r\,T}{2\pi\, c_4}\sqrt{\frac{c_2^2 c_3^2 - c_1^2 c_4^2}{c_1^2 - c_2^2}} \qquad (14a)$$

$$\tan\omega = \frac{1}{c_4}\sqrt{\frac{c_2^2 c_3^2 - c_1^2 c_4^2}{c_1^2 - c_2^2}} \qquad (15a)$$

(B.) With the additional resistance: $r_0 = R$.
Therefore : $c_5 = c_3$.

$$X = \frac{r\,T}{2\,\pi\,(2\,c_4 - c_3)} \sqrt{\frac{c_3^2 c_2^2 - c_1^2 c_4^2}{c_1^2 - c_2^2}} \qquad (14b)$$

$$\tan\,\omega = \frac{1}{2\,c_4 - c_3} \sqrt{\frac{c_3^2\,c_2^2 - c_1^2\,c_4^2}{c_1^2 - c_2^2}}. \qquad (15b)$$

A few examples will show the application of this method:

1. In the electro-dynamometer-ammeter which was mentioned above, the resistance was very low : $r = .01$ ohm. Therefore, an additional resistance r_0 was used. As a current indicator a small continuous current ammeter was used.

$T = .01$ second.

It was found that for alternating currents :

$c_1 = 18.527$ amperes ; $c_2 = 10.679$ amperes.

For continuous currents :

$c_3 = 9.526$ amperes ; $c_4 = 5.074$ amperes.

Therefore, by formula (14b) and (15b) :—

$X = .0000657$ henry,

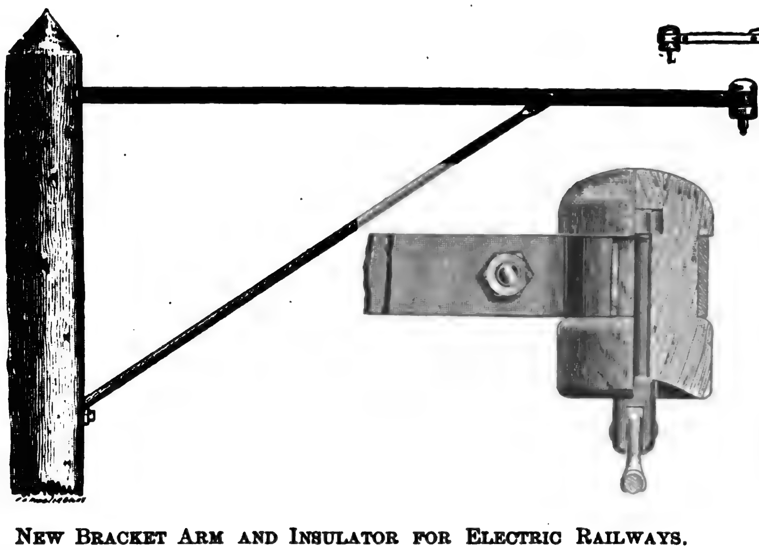
the coefficient of self-induction of this ammeter ; and the angle of shifting of phase :—

angle $\omega = 76.4$ degrees.

$$r_0 = R = \frac{r\,(c_3 - c_4)}{2\,c_4 - c_3} = .056 \text{ ohm.}$$

2. In a low-reading voltmeter of the electro-dynamometer type the resistance was :—

$r = 19.68$ ohm.
$r_0 = 0$;



New Bracket Arm and Insulator for Electric Railways.

no additional resistance used.

The same continuous current ammeter as in the former instance was used as a current indicator, but with about 13 ohms ordinary resistance in series.

It was found :

For alternating currents :

$c_1 = .3478$ ampere ; $c_2 = .1697$ ampere.

For continuous currents :

$c_3 = .3734$ ampere ; $c_4 = .1628$ ampere.

Therefore, by formulas (14a) and (15a) :—

$X = .03543$ henry,

the coefficient of self-induction of this voltmeter; and the angle of shifting of phase:

Angle $\omega = 29.5$ degrees.

$$R = \frac{r\,(c_3 - c_4)}{c_4} = 25.45 \text{ ohms;}$$

and $$\frac{1 - \cos\,\omega}{\cos\,\omega} = .149 = 14.9 \text{ per cent.}$$

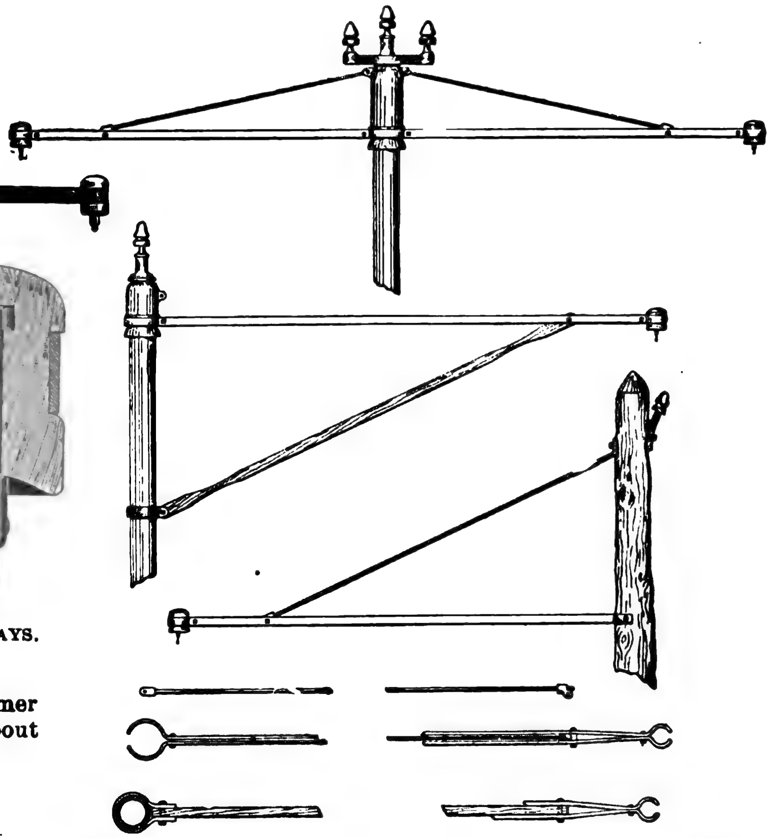
Therefore for such alternating currents of 100 full periods per second the readings of this instrument have to be increased by 14.9 per cent. to get the correct voltage. The correction for any other number of periods can easily be calculated.

This method is open to the objection of inaccuracy upon the assumption that the alternate currents are true sine-waves. But in looking further into the matter, we shall often find this to be of advantage for practical purposes.

Because, if we do not want to know the absolutely exact value of the coefficient of self-induction for scientific purposes, but want to use the instruments to measure alternating dynamo currents and the behavior of inductive resistances toward them, then the figures obtained in this way hold good for the same kind of dynamo currents, and allow us to assume them again as true sine-waves in the calculations of electric machinery. Besides, in most of the alternators built to-day, the deviation of current from the sine-wave is rather small.

NEW BRACKET ARM AND INSULATOR FOR ELECTRIC RAILWAYS.

The accompanying cuts shows a new form of bracket arm which attracted much attention at the recent Buffalo Street Railway Convention, and which has several distinct advantages over the existing forms. The cut shows



New Bracket Arm and Insulator for Electric Railways.

the simplest possible form, although the same principle readily admits of ornamentation. The arm consists of two flat bars bolted together. At their inner end they are bent apart so as to partially clasp the pole, and have holes near their extremities by which the arm is attached to the pole with lag screws. A brace clamped between the two bars supports the arm from above or below. The outer ends of the bars are so shaped that when clamped together they embrace and hold an insulator specially designed for the purpose. The insulator is firmly held in a vertical

position, and a brass foot is riveted into a malleable iron stem with a stout and deeply forked end. This admits of free oscillation of the foot in the line of the wire, but no lateral movement. The advantages of this arm are its great simplicity and strength. It is attached to the pole in such a manner that a break or slacking of the wire will not injure it or its attachment to the pole. It is suitable for curve and straight line work. The insulator is strong and efficient, and exactly suited to the work required of it. This form of bracket arm is made also for use with iron poles, in which case it clamps at the inner end to an insulated iron pole top of special design, and is so arranged that the entire bracket arm is insulated from the pole. These devices are manufactured by Emmet Bros., of this city. They are being used in large quantities by the North American Construction Co., of Pittsburgh.

A NOVEL WIRE CONNECTOR FOR HEAVY WIRES.

Good joints in wires for electric circuits, whether for indoor or aerial work, are recognized to be just as important for successful work as the necessity for good copper. We illustrate in the accompanying engraving a new form of connector, called the Brennan "No-Solder" Wire Connector, a device designed more especially for jointing large wires ranging from No. 0 to No. 00000 in size. This connector, which was patented on October 14, is made of cast bronze, the holes being drilled to fit the wire to be connected. The horizontal slot joining the two holes, as shown, is made so that the connector will grip the wire tight and make a good electrical contact when pounded with a hammer. When stranded wires are used, solder may be applied

Novel Connector for Heavy Wires.

at the slot running across the face of the connector. The Pettingell-Andrews Company, of Boston, are introducing these goods and have the exclusive sale for the whole of the United States.

WESTERN UNION TROUBLES IN THE WEST.

A special dispatch from Chicago of Oct. 27th says:—"The trouble between the Western Union Telegraph Company and its operators grows daily more serious and promises to become widespread. It already extends over a good deal of territory throughout the West. The entire night force of the St. Paul office, to the number of thirty-seven, struck to-night and left the office in a body. It is reported here that the day force, numbering about 50 men, will refuse to report for duty at 8 o'clock to-morrow morning. St. Paul is the repeating station for the Northwest, and the entire telegraphic business of the Northwest is paralyzed.

"The strike was precipated by the discharge of operators Cooper, Gibbons, Moore, Dempsey, Leadsworth, and Patterson, late on Saturday afternoon. The men were discharged while at work at their wires. They were all supposed to be prominent in the new Telegraphers' Brotherhood, and, when one of them pressed the official who executed the orders for a reason, he replied: 'You know very well.'" There is trouble of the same kind at St. Louis.

THE WOOD DOUBLE BREAK LIGHTNING ARRESTER.

The experience gained during past years in arc lighting, which has been amply confirmed by numerous experiments, has demonstrated that lightning arresters in order to be effective in their action must not present to the path of the discharge any inductive resistance. Such a resistance, if in circuit, evidently creates an enormous counter E. M. F. which opposes the discharge to earth and is apt to cause

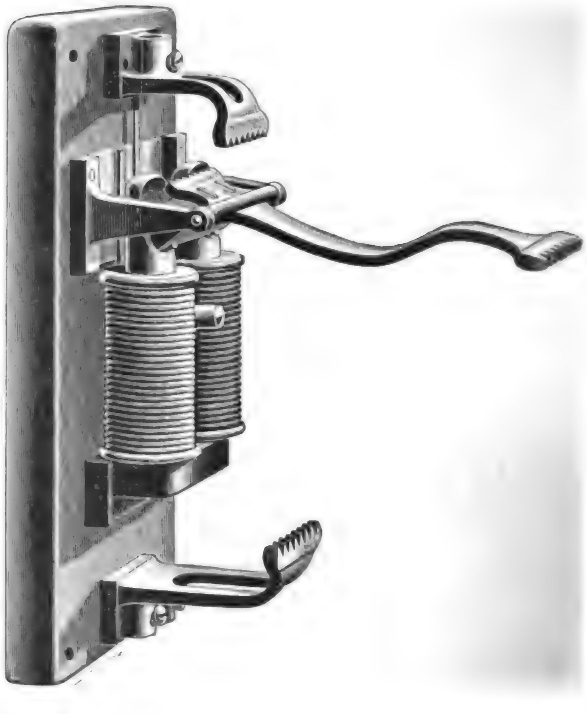


Fig. 2.—Wood's New Lightning Arrester.

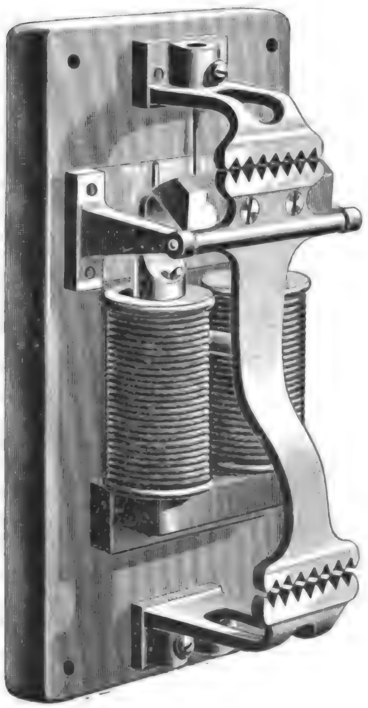
the destruction of the machines which the arrester is designed to protect. The modern form of lightning arrester designed for arc lighting purposes, while preserving the saw tooth form of arrester, has therefore been modified to prevent the maintenance of the arc which would be due to the current from the dynamo following the flash to ground. For this purpose several devices have been constructed, which, upon the passage of a discharge, separate the saw teeth and those break the arc and the current to ground at the same time. This breaking of the arc is usually effected by the action of electro-magnets in circuit with, and a part of, the arrester.

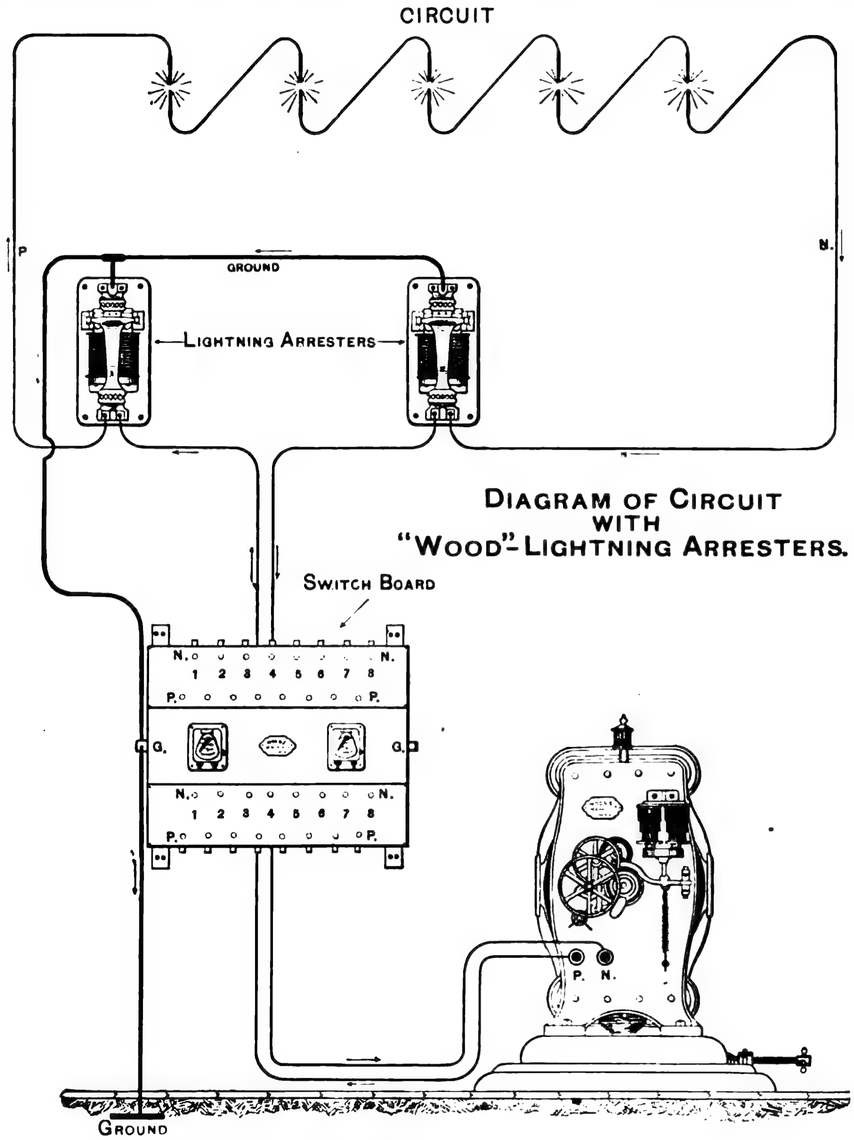
But it is evident that while this device is in itself a very useful one, the precaution to be observed with regard to the insertion of inductive resistances still holds true. It is a well known fact that the current will jump an air space of very high resistance in preference to passing through such an electro-magnet.

To avoid this action, therefore, but at the same time to retain the electro-magnet to break the arc, Mr. J. J. Wood, the electrician of the Fort Wayne Electric Co., has recently designed an ingenious lightning arrester, which is illustrated in the accompanying engravings. Here Fig. 1 shows the arrester in its normal condition ready to receive a discharge to earth and Fig. 2 shows its condition immediately after receiving such a discharge. As will be seen, the arrester consists of a cross-bar pivoted horizontally, carrying two tongues, an upper short one, and a lower one of greater length. These tongues are serrated and come opposite similar saw tooth plates. Attached to the horizontal pivoted shaft is a soft iron armature which is acted upon by the prolonged cores of the electro-magnets so that when a discharge passes through the arrester the armature is attracted and swings the tongues out of

their original position, breaking the arc at two points, above and below, as shown in Fig. 2. As soon as the discharge has taken place and the current is broken, the arrester at once falls back to its original position due to the overbalancing of the armature by the lower tongue.

The distinguishing feature of the arrester, however, consists in the fact, that instead of being placed in series with the arrester points, the electro-magnets which serve to break the arc are placed in a shunt around the upper pair. The result of this is that the discharge, instead of being required to pass through the electro-magnets and then through the discharge plates, has two paths open to it, one directly across the discharge plates without any hindrance,





FIGS. 1 AND 3.—WOOD'S NEW LIGHTNING ARRESTER.

and another through the electro-magnets. Assuming then that the discharge would prefer to pass directly across the plates, the current to earth established thereby would have a part of it immediately shunted through the electro-magnets, which, being energized, at once attract the armature and break the arc by separating the plates at the two points.

The diagram, Fig. 3, shows very clearly the arrangement of the circuits. The circuit after passing through the switch-board is connected to the lower plate of the lightning arrester, passes from there through the lamps, back to the incoming lightning arrester and back to the machine. The upper terminals of the lightning arresters are connected to ground. This ingenious arrester is now being manufactured at the works of the Fort Wayne Electric Co., in Brooklyn, N. Y.

ELECTRIC WELDING APPLIED TO THE MANUFACTURE OF PROJECTILES.[1]

BY LIEUT. W. M. WOOD, U. S. N.

AFTER describing the tedious and expensive methods heretofore in vogue, Lieut. Wood proceeded to the explanation of the new processes adopted, with the aid of the Thomson electric welding apparatus as follows:

First, instead of the solid, rough-forged ingot, we have these three component parts, which when welded together will form a 6 lb. armor-piercing shell. Each piece is now finished to exact size, except that there is a little extra length to allow for the take-up in welding. The head and base pieces are forged in dies to shape; the central portion is simply a piece cut from a length of solid drawn steel piping. It has all the additional strength due to the fibrous skin inside and out caused by the drawing process. To join these three pieces, they are clamped into a form of electric welding machine designed for the purpose, and in less than a minute are joined together and made a homogeneous mass like this.

It only now remains to grind off the two burrs which you see in this specimen, and cut in the groove for the rotating band. The front one of these burrs may be used to form an enlargement used in many forms of projectiles, called technically, a "bourillet." It supports the front portion of the shell in the bore of the gun, the remainder not touching except at the rotating band. The other burr may be removed at the same time the rotating band groove is cut. The fuse hole has already been cut and threaded in the base piece. The shell is now ready for the hardening process. I wish to call attention here to the fact that the burrs are allowed to remain on the inside and thus form

1. Abstract of paper read before the Boston Society of Arts, Boston, Oct. 23, 1890.

strengthening ribs which help materially to support the shell against the great crushing strain it receives on impact. You will see that we have thus formed a stronger and better shell with minimum of labor on the individual parts and a few seconds' work to join them together.

In order to illustrate the wonderful strength that may be gained by this welding process, I have here a shell which was constructed exactly as I have shown. It was fired through a 3-in. plate of iron at the Naval Proving grounds at Annapolis, recently. You will see that it has not changed its shape in the slightest degree, nor has it even lost the copper rotating band which was carried through the hole with it. Here is another which shows a still more remarkable result. This projectile was fired against heavy steel armor which has a resistance of about 75 per cent. more than iron and which was much heavier than a projectile of this size could be expected to perforate. It, however, penetrated 5 inches, and then, owing to the elasticity of the oak backing of the plate, was thrown back about 30 feet, as perfect in condition as before it was fired from the gun. The experience of the Welding Company has been that the metal seems to be strengthened at the point of welding and this certainly seems to justify the supposition.

A NEW METHOD OF ANALYZING THE MAGNETIC REACTIONS OF ARMATURES APPLIED TO THE STANLEY ARC LIGHT ALTERNATING CURRENT MACHINE.[1]

BY THORBURN REID.

THIS analysis is a result of looking at an old and well-known phenomenon from a new point of view, and is merely a development of the principle of the magnetic circuit a little further than has heretofore been usual. Hopkinson, I find, has used much the same method in his analysis of the transformer, and seems vaguely to have foreseen its application to dynamos; if I may judge from a part of a sentence which I ran across in one of his articles a few days ago, this same principle has been discussed at some length in the English electrical journals lately, but I am not aware that any analysis has been attempted by means of it.

By this conception dynamos are considered to consist of a magnetic circuit composed partly of iron (or steel) and partly of air, one part being at rest and the other in motion (generally rotary). Magnetism is induced in this circuit by means of two or more coils of wire carrying an electric current, wound around some part or parts of the circuit. One or more coils may be wound on the fixed part of the circuit and one or more on the moving part, and the magnetism induced will be that due to the sum of all the magneto-motive forces in all the coils, divided by the sum of all the magnetic resistances. The magneto-motive forces in the fixed

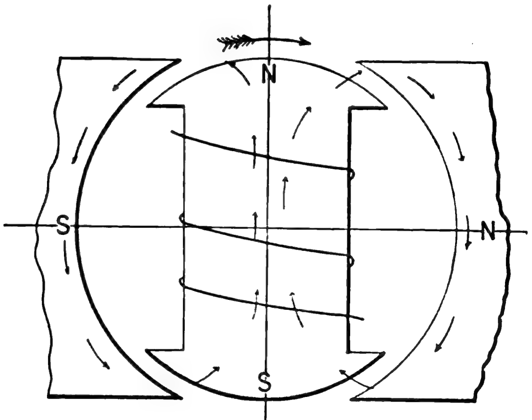


Fig. 1.

coils are generally approximately constant, except where they are varied for purposes of regulation. In the movable coils, however, the M. M. F. is generally variable. In direct current machines its effect on the total flux around the magnetic circuit is also almost inappreciable, chiefly for the reason that it acts almost at right angles to the magnetic circuit. In alternating current machines, however, it is quite considerable, and is generally taken into account, but attributed to the self-induction of the armature. The connection between the counter M. M. F., as it may be called, of the armature and its self-induction will be brought out more fully in a subsequent part of this paper.

1. A paper read before the American Institute of Electrical Engineers, New York, October 21st, 1890.

To simplify our conceptions we will assume a two pole dynamo with one coil on the armature, as shown in Fig. 1. Referring to the diagram, Fig. 2,

Let $\overline{ON} = N$, represent the magnetic induction through the armature due to the field in magnitude and direction.

Let $\overline{OO'}$ represent the position of the armature coil at that instant.

Let $\overline{OA} = A$, at right angles to $\overline{OO'}$, represent the magnetic induction due to the armature coil at that instant.

Let $\overline{PP'}$, at right angles to the field lines, be the neutral line.

Let $POC = \theta$ be the angle through which the coil has moved from its neutral position.

By completing the parallelogram, and thus compounding the two magnetizations N and A, we obtain $M = \overline{OR}$ as the resultant magnetic induction through the armature coil in amount and direction, at that instant, and $\overline{QQ'}$, at right angles to $\overline{OR}$, as the

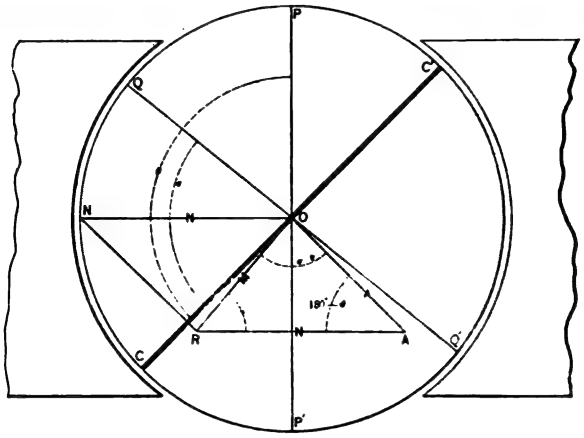


FIG. 2.

neutral line with reference to this resultant magnetization. Then QOC $(= \sigma)$ is the angle through which the coil has turned from this new neutral line.

Let the angle $\overline{NOR}$ $(= ORA) = \alpha$. We are to deduce the value of M from the known quantities N, A, and the angle θ. In the triangle ROA, $\overline{RO}$ is perpendicular to $\overline{OQ}$ and $\overline{OA}$ is perdendicular to $\overline{OC}$; therefore the anglo $ROA = \overline{QOC} = \sigma$.

Also $\overline{OA}$ is perpendicular to $\overline{OC}$ and $\overline{AR}$ is perpendicular to $\overline{OP}$; therefore $\overline{OAR} = \overline{OOP} = 180° - \theta$.

From trigonometry we have :—

$$\frac{M}{\sin (180° - \theta)} = \frac{N}{\sin \sigma} = \frac{A}{\sin \alpha};$$

or

$$\frac{M}{\sin \theta} = \frac{N}{\sin \sigma} = \frac{A}{\sin (\theta - \sigma)} \qquad (1)$$

therefore

$$N \sin (\theta - \sigma) = A \sin \sigma.$$

Expanding $\sin (\theta - \sigma)$, dividing by $\cos \sigma$ and solving for $\tan \sigma$, we have

$$\tan \sigma = \frac{N \sin \theta}{N \cos \theta + A} \qquad (2)$$

whence by trigonometry

$$\cos \sigma = \frac{N \cos \theta + A}{\sqrt{N^2 + 2\, A\, N \cos \theta + A^2}} \qquad (3)$$

$$\sin \sigma = \frac{N \sin \theta}{\sqrt{N^2 + 2\, A\, N \cos \theta + A^2}} \qquad (4)$$

Therefore, from equation (1)

$$M = N \frac{\sin \theta}{\sin \sigma} = \sqrt{N^2 + 2\, A\, N \cos \theta + A^2} \qquad (5)$$

This last expression gives us the actual value of the induction through the armature coil at that instant in terms of the field strength, the armature strength and the angle θ through which the coil has been turned from the position perpendicular to the field lines. The direction of this resultant magnetization is along $\overline{OR}$, and the neutral line has been shifted from $\overline{OP}$ to $\overline{OQ}$ and the number of lines actually passing through the coils is $M \cos \sigma$.

From equations (3) and (5) we obtain $M \cos \sigma = N \cos \theta + A$.

The E. M. F. at any instant is then

$$E = -\frac{d}{dt}\left\{ S N \cos\frac{2\pi t}{T} + S A \right\} \quad (6)$$

where S is the number of turns in the coil; t is the time which has elapsed since the coil passed the position $\overline{OP}$, and T is the time of one revolution.

Therefore,

$$E = \frac{2\pi S N}{T} \sin\frac{2\pi t}{T} - S\frac{dA}{dt} \quad (7)$$

The armature magnetization, A, depends on the number of turns in the coil, on the current flowing through it, and on the magnetic resistance offered to its lines of force; or

$$A = \frac{S i}{\rho} \quad (8)$$

where ρ is the magnetic resistance, and i the instantaneous value of the current.

Letting $\frac{S^2}{\rho} = L$, dividing through by R, the resistance in the main circuit, and collecting the terms, we have

$$\frac{di}{dt} + \frac{R}{L} i = \frac{2\pi S N}{L T} \sin 2\pi\frac{t}{T} \quad (9)$$

Let

$$\frac{2\pi S N}{L T} = a,\ \frac{2\pi}{T} = p, \text{ and } \frac{R}{L} = b,$$

and we have

$$\frac{di}{dt} + b\, i = a \sin pt \quad (10)$$

a differential equation which must be integrated.

This equation may be reduced to the following form

$$i = e^{-bt}\int a \sin pt\, e^{bt}\, dt \quad (11)$$

which may be integrated by parts thus

$$i = a e^{-bt}\int e^{bt} \sin pt\, dt$$

Let $u = \sin pt$ and $dv = e^{bt}\, dt$; then $du = p \cos pt\, dt$ and $v = \frac{1}{b} e^{bt}$; $\int u\, dv = \frac{1}{b} e^{bt} \sin pt - \int \frac{1}{b} e^{bt} p \cos pt\, dt$;

$$i = \frac{a}{b} \sin pt - \frac{ap}{b} e^{-bt} \int e^{bt} \cos pt\, dt.$$

Let $u = \cos pt$, and $dv = e^{bt}\, dt$; then $du = -p \sin pt\, dt$, and $v = \frac{1}{b} e^{bt}$ $\int u\, dv = \frac{1}{b} e^{bt} \cos pt + \int \frac{1}{b} e^{bt} p \sin pt\, dt$;

therefore $i = \frac{a}{b} \sin pt - \frac{ap}{b^2} \cos pt - \frac{p^2}{b^2} i$; or

$$i = \frac{a}{\sqrt{p^2 + b^2}}\left\{ \frac{b}{\sqrt{p^2 + b^2}} \sin pt - \frac{p}{\sqrt{p^2 + b^2}} \cos pt \right\}$$

Let $\tan^{-1} \varphi = \frac{p}{b}$. Then substituting for a, b and p, their values, we have

$$i = \frac{2\pi S N}{\sqrt{R^2 T^2 + 4\pi^2 L^2}} \sin(\theta - \varphi) \quad (12)$$

where φ is the angle of lag, or the angle by which the effective E. M. F. lags behind the impressed E. M. F.

This is the instantaneous value of the current at any instant. Since the average value of the square of the sine of any angle is ½, we have, calling C the square root of the average square of the current:

$$C = \frac{\sqrt{2}\, \pi S N}{\sqrt{R^2 T^2 + 4\pi^2 L^2}} \quad (13)$$

$$E = \frac{\sqrt{2}\, \pi S N R}{\sqrt{R^2 T^2 + 4\pi^2 L^2}} \quad (14)$$

You will no doubt have already recognized this equation as the ordinary equation of the alternating current dynamo, *when the self-induction of the armature coils is taken into account.* This analysis so far has taken no account of the self-induction in the armature coil. There has, however, been introduced into the discussion a factor not generally treated in this connection, namely, the counter M. M. F. of the coil. This factor occurs in the equation as the expression for which I have used the letter L. L is ordinarily used to denote the coefficient of self-induction, and I chose it for that very reason. The connecting link is shown by the value given to L in our equation; namely $\frac{S^2}{\rho}$.

We shall now show that L, the coefficient of self-induction of a coil, is equal to the square of the number of turns in the coil, divided by the magnetic resistance of the circuit, through which the lines of force of the current flowing in the coil must travel. There are several ways of getting at a definition of L and perhaps the simplest is the following:

The counter E. M. F. of self-induction of a coil, in which a varying current is flowing, is $L\frac{di}{dt}$ where $\frac{di}{dt}$ is the rate of change of the current at the instant considered; or, more simply, if the current is changing at a constant rate, it is the number of amperes through which the current is increasing or decreasing in a second. If the current is changing at the rate of one ampere in a second, $\frac{di}{dt}$ becomes unity and $L\frac{di}{dt}$ becomes equal to L. Therefore L represents the counter E. M. F. of self-induction of a coil, in which the current is changing at the rate of one ampere in a second.

Now selecting suitable units, the number of lines of force which will be sent around a magnetic circuit of magnetic resistance ρ by a current of one ampere flowing through a coil of S turns, will be $\frac{S}{\rho}$. Therefore if the current is increasing at the rate of one ampere per second, $\frac{S}{\rho}$ lines of force will be inserted or taken out of the coil in a second, and the E. M. F. set up will be $\frac{S}{\rho} \times S = \frac{S^2}{\rho}$; but, since the current is changing at the rate of one ampere per second, the E. M. F. set up $= L$. Therefore $L = \frac{S^2}{\rho}$.

These equations (13 and 14) might have been arrived at a little differently by resolving the counter magneto motive force of the coil parallel to the induction due to the field, and then considering the comparative values of the resistances through the inside of the coil and around the outside; but this method is more complicated than the one I have chosen, and a little consideration will show that it is precisely the same thing, merely looked at from a different point of view.

Now let us see how this equation must be modified to suit the conditions obtaining in the Stanley alternating arc machine. This machine is of the multipolar type, with the coils laid flat on the armature core. It differs from the ordinary Westinghouse alternating machine mainly in the facts that each coil consists of a large number of turns, and is laid in longitudinal grooves in the armature core in such a manner as to be almost entirely surrounded by iron, and that the number of alternations per second is large. As a result of this arrangement the machine maintains a nearly constant current throughout wide variations of resistance and speed.

To explain this phenomenon we will use equation (13), first substituting for L its value, $\frac{S^2}{\rho}$, and we have

$$C = \frac{\sqrt{2}\, \pi S N}{\sqrt{R^2 T^2 + 4\pi^2 \frac{S^4}{\rho^2}}} \quad (15)$$

Since there is a large number of turns in the armature coil, S is very large and S^4 correspondingly larger. Then, since the coil is almost completely surrounded by iron, ρ is very small, and accordingly $\frac{S^4}{\rho^2}$ is exceedingly large. Then, since the number of alternations is very large, T, the time of one alternation, is a very small fraction, and, therefore, $R^2 T^2$ may be neglected as compared with $4\pi^2\frac{S^4}{\rho^2}$. Neglecting this term then and reducing, our equation becomes

$$C = \frac{N \rho}{\sqrt{2}\, S} \qquad (16)$$

This equation shows that C is dependent on the magnetic induction through the coil due to the field, on ρ the magnetic resistance to the lines of force of the coil, and on S, the number of turns in the coil. *Resistance and speed are conspicuous by their absence.*

We must remember, however, that if R and T are increased

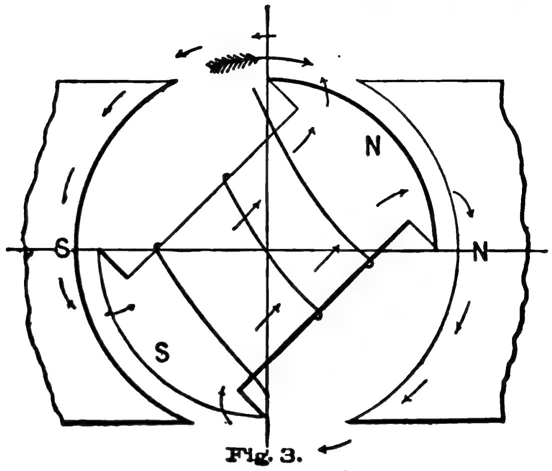


Fig. 3.

sufficiently in value, $R^2\ T^2$ will cease to be negligible as compared with $4\ \pi^2 \frac{S^4}{\rho^2}$, and therefore, every increase in R will increase the denominator of equation (15), and C will decrease.

If, therefore, we fix the limits between which the current may change, while the resistance in the main circuit is changing from its lowest to its highest value, we may determine the speed below which the machine must not run. Any increase of the speed above this point merely tends to lessen the fluctuation of the current between the highest and lowest resistances. Again, any increase in the speed above this point will widen the range throughout which the resistance may vary, without the fluctuation in the current passing the prescribed limit. R will have its lowest value when the armature is short-circuited, and will then equal the resistance of the armature coils, and the current will be at its maximum value. The minimum value of the current then

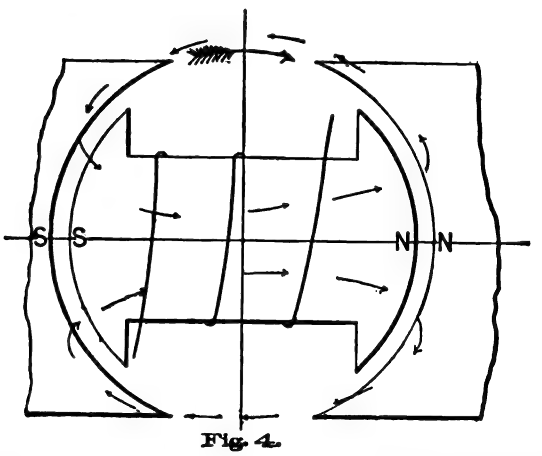


Fig. 4.

being fixed, the maximum value of R will depend on the value of $R^2\ T^2$, as compared with $4\ \pi^2 \frac{S^4}{\rho^2}$ or R (maximum) may vary inversely with T, or directly as the number of alternations per second.

Returning now to equation (16) we see that C varies directly as N (the field is separately excited) and N varies directly as the exciting current. Therefore any increase in the magnetizing current will correspondingly increase the main current. This is in fact the method by which the main current is brought to its proper value. The machine is short-circuited and the main current brought to its proper value by varying the magnetizing current. The main current will then remain practically constant throughout the prescribed range of resistance.

Secondly, the current varies directly as ρ. This, too, has been shown to be true, for in one of the first machines built the coils were wound in cylindrical longitudinal holes in the armature core so that they were entirely surrounded by iron, and as a result the current obtained was too small to be measured. Longitudinal slots were then cut in the armature core so as to increase ρ, and by widening these slots to the proper amount, the desired current was obtained.

Finally C varies inversely as S, the number of turns in the armature coil. That is, the more turns in the armature coil the less the current delivered. This, too, was found to be true in the experimental stage of the work. But it must be remembered that S must not be made so small that the term $4\ \pi^2 \frac{S^4}{\rho^2}$ becomes comparable with $R^2\ T^2$. We may perhaps obtain a simple conception of the reaction by slightly changing the form of our equation. We may write equation (15) thus,

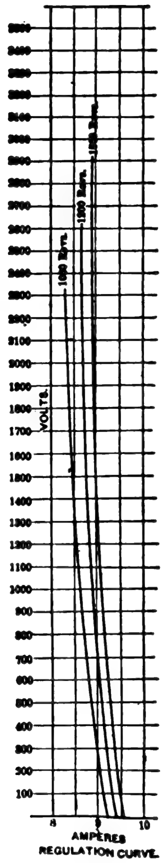


Fig. 5.

$$C = \frac{\sqrt{2}\, \pi\, S\, N}{R\ T \sqrt{1 + \frac{4\ \pi^2\ L^2}{R^2\ T^2}}} = \frac{\sqrt{2}\, \pi\, S\, N}{R\ T\ \sqrt{1 + \tan^2 \varphi}} \qquad (17)$$

where φ is the angle of lag.

Neglecting the term 1, under the radial sign, we have

$$C = \frac{\sqrt{2}\, \pi\, S\, N}{R\ T \tan \varphi} \qquad (18)$$

$\tan \varphi$ varies inversely as $R\ T$, and therefore the product of $\tan \varphi$ and $R\ T$ in the denominator remains constant. Referring to Fig. 1, and remembering that φ is the angle by which the effective E. M. F. lags behind the impressed E. M. F., we observe that if there is no lag the effective E. M. F., or, the current will reach its maximum value when the coil is in the position shown in Fig. 1; and therefore the largest possible number of lines will flow through the coil and will be taken out of it during the revolution. As φ increases, the current is delayed in reaching its maximum value, until the coil has passed the position shown in Fig. 1, and when φ is nearly 90° the coil will have nearly attained the position shown in Fig. 4 before the current reaches its maximum value; but in this position the M. M. F. of the coil almost exactly opposes that of

the field, thus largely reducing the number of field lines which will pass through the coil. As φ increases, the E. M. F. decreases. Then we have: a decrease in R tends to increase the current, but a decrease in R tends to increase φ, which, in turn, decreases the effective E. M. F. and reduces the current. φ must be nearly 90° so that the demagnetizing effect of the coil may vary inversely as R, which it will not do if φ is small. The result may be viewed in still another way; we may write our equation thus,

$$C = \frac{\sqrt{2}\,\pi\,S\,N\,n}{\sqrt{R^2 + 4\,\pi^2\,L^2\,n^2}} \quad (19)$$

where n is the number of complete waves per second. The numerator of this fraction will then represent the E. M. F., which would be set up in the coil, if there were no self-induction. The denominator consists of the ohmic resistance R, and of another term due to self-induction, which is equivalent to an added resistance and has been called the inductance. This quantity $2\,\pi\,L\,n$ multiplied by C will equal the counter E. M. F. of self-induction of the coil. As long, then, as the inductance or induction resistance of the coil is very large as compared with the ohmic resistance, any change in the ohmic resistance will only very slightly affect the total resistance, which is the sum of the two.

Let us now consider what light these equations will throw on the question of designing the machine. The problem is to obtain a current of the desired strength and constancy, with the least

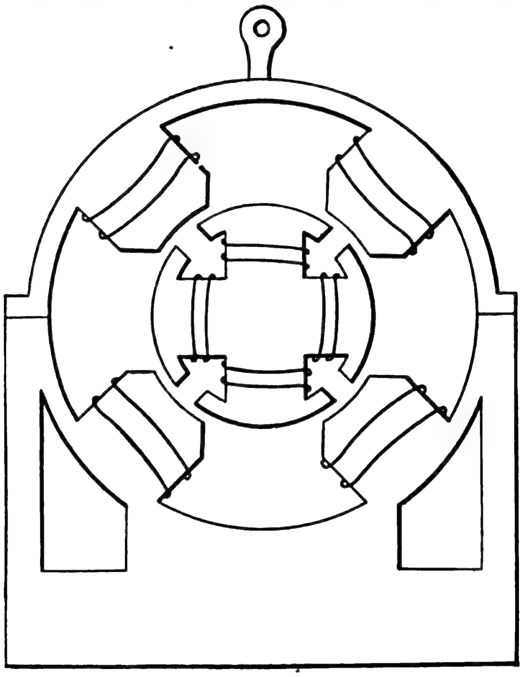


Fig. 6.

expenditure of energy and at the least expense, and the quantities with which we may work to obtain this result are $N\,S\,\rho$ (or L) and T. We see immediately that it is advantageous to make T as small as mechanical considerations will allow, since the smaller T is, the more constant will the current be throughout the range, or the wider the range the resistance may have without causing the current to vary below the prescribed limit. This points then to a multiplicity of poles, or high speed, or both.

N, on the other hand, should be as large as possible, for the output of the machine varies directly with that factor, and its increase does not at all affect the fluctuation of the current. S, again, should be as small as it can be made without affecting too much the regulation of the machine.

ρ is the one indeterminate quantity in this equation. It is almost impossible to calculate its value beforehand to any reasonable degree of accuracy, for several reasons. The magnetic circuit of which it is the resistance, varies in cross section throughout its whole length, and this variation is not uniform but has several points of discontinuity. Furthermore, ρ varies during the revolution of the armature, for when the armature pole is half way between two field poles, part of the path of the lines of force is through the field pole, and when the armature pole is opposite the field pole, that same part of the path of the lines of force will be made up of the air gap between the two field poles, and ρ will be much increased. An approximate value might be obtained by determining L with the armature in different positions and taking an average of the values thus obtained; but if in actual practice the iron is worked anywhere near the saturation point, this method would be of doubtful utility, unless the currents used in determining L were the same as those used in practice.

Probably the best method for practical work would be by means of a curve of current and E. M. F., where, all the terms being known except ρ and probably N, we can obtain $n\,\rho$ from one point on the curve, and both ρ and N from two points. This method, while it would probably not give us very accurate values of these two terms, would be of value for purposes of comparison, so that by means of a large number of determinations we might obtain data which would be very useful in designing future machines.

Another useful thing to know is what is the highest value which the E. M. F. will attain on open circuit. This may be obtained from equation (14) thus: Dividing both numerator and denominator by R and neglecting the second term under the radical sign (since R is infinite on open circuit) we have,

$$E = \frac{\sqrt{2}\,\pi\,S\,N}{\sqrt{T^2 + \frac{4\,\pi^2\,L^2}{R^2}}} - \sqrt{2}\,\pi\,S\,N\,n \quad (20)$$

where n is the number of complete periods per second.

This E. M. F. will of course be very high, since there are very many turns in the armature coil, and n, the number of periods per second, is very large. As a consequence of this, if the machine is allowed to run on open circuit, the armature insulation will soon break down, thus producing a ground which will speedily burn out the machine.

The following is the complete formula where all the terms are expressed in practical units.

$$C = \frac{\sqrt{2}\,\pi\,S\,N}{10\sqrt{10^{18}\,R^2\,T^2 + 12.768^2\,\pi^2\,S^4\,\mu^2\,\frac{A^2}{l^2}}} \quad (21)$$

INVESTIGATION OF THE STANLEY ALTERNATE CURRENT ARC DYNAMO.[1]

BY W. B. TOBEY AND G. H. WALBRIDGE.

BEFORE entering directly upon the subject to be presented this evening, *i. e.*, the investigation of the Stanley alternate current arc dynamo, it may be well to give a brief description of that new and extremely novel type of machine. Descriptions of it have been given in some of the electrical papers during the past spring, but some here may not recall its general mechanical construction. The dynamo is manufactured and sold by the Westinghouse Electric Company under patents granted to Mr. Wm. Stanley, Jr., the inventor. Mr. Albert Schmid, superintendent of the Westinghouse Electric Company's shops, deserves much credit for perfecting the machine in detail, and to him is largely due its success commercially. In general appearance it closely resembles the Westinghouse alternate current constant potential dynamo, which has become so familiar to all. In fact, the frame, pole pieces, field windings, etc., for any given size machine are identical, whether for constant current or constant potential. The distinguishing feature between them lies wholly in the form and winding of the armatures. Figs. 12 and 13, showing diagrammatically half sections of the machine, will aid us in a description of the armature, which is built up of thin iron plates stamped in the form shown. It will be observed that a number of cores corresponding to the number of poles off the dynamo project radially from the armature, and from the sides of each core project overlapping lugs. The armature coils are not of the original "pancake," or oblong flat coil type, placed on the periphery of the armature, but are quite thick and placed around the core projections. The overlapping lugs serve the double purpose of preventing the coils from slipping off the cores and also aid in the regulation of the machine. All the armature coils are connected in series and the terminals connected to the two collector rings, upon which bear the brushes furnishing current to the line. The field coils are also in series, so connected that the poles presented to the armature are of alternate polarity. The terminals of the field go directly to a small shunt wound exciter. Thus it is seen that the machine consists simply of an even number of field coils, corresponding to the number of poles on the machine, joined in series, and an equal number of armature coils also joined in series. That from such a simple combination of coils without any external regulating device, an almost constant current is obtained for all loads, from short circuit to the maximum output of the machine, seems incredible, but such is the case.

Through the kindness of Mr. Stanley, a complete 40-light plant was sent the writers at Cornell University, at which institution

1. A paper read before the American Institute of Electrical Engineers, New York, Oct. 21, 1890.

we were then students. Later, the Westinghouse Company made the University a gift of the entire plant. It has been our aim to show how the regulation takes place; also to determine the actual electrical output of the machine, and from the latter and the corresponding dynamometer readings to calculate the efficiency of the dynamo.

The alternator was mounted on a bracket cradle dynamometer calibrated to read in watts direct at 1000 revolutions, the speed at which we were running.

The general method has been to obtain instantaneous values of E. M. F., arc and exciter currents at a sufficient number of points to indicate by curves the performance of the dynamo at every part of a revolution. For this purpose runs were taken with the

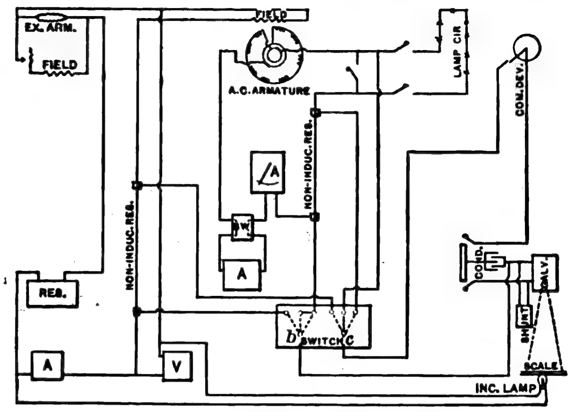


Fig. 1.—DIAGRAM OF CONNECTIONS.
A, A, A. Ammeters; V. Voltmeter.

dynamo at short circuit and with loads of 5, 10, etc., up to 40 lamps. The dynamo was run under normal conditions, viz., at a speed of 1000 revolutions and with such excitation as to cause an output of approximately 10 amperes. For obtaining values of E. M. F. at low loads, pressure wires were run from the terminals of the dynamo and for larger loads were taken from around 10 lamps. At all points where instantaneous values of E. M. F. were taken corresponding values of arc and field, or exciter currents were obtained by "fall of potential" method. Pressure wires were brought from the terminals of each of two non-inductive resistances of German silver wire placed in arc and field circuits. (See Fig. 1.) These resistances being constant, any pressure around the terminals corresponded to a certain current. The termi-

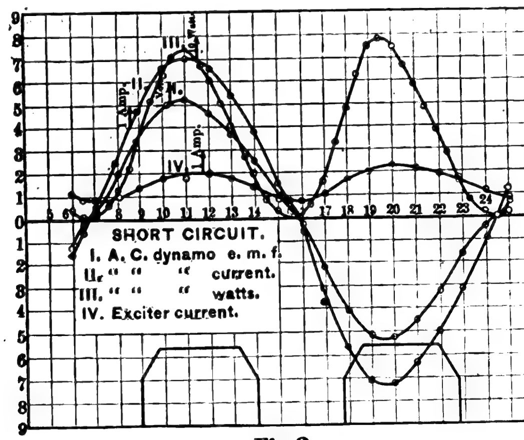


Fig. 2.

nals of the three pairs of pressure wires were connected to the contacts of the triple-throw switch, so that by placing the switch on any pair of contacts desired, those terminals could be put in circuit with a line in which was a condenser and the revolving contact or commutating device by means of which the condenser was charged. The revolving contact used was similar to the one described in detail by Prof. Ryan in his article on "Transformers," read before the Institute last December.[1] It consists essentially of a knife edge of steel fastened by a wooden clamp to the collector end of the armature, and revolving with it through a circle of about eight inches diameter. The centre of the knife edge was in line with the centre of one of the armature coils. Upon a frame at the same end of the armature was held a wooden semicircle, upon the periphery of which was a paper scale, divided to

1. See Transactions of the American Institute of Electrical Engineers, Vol. VII., p. 1.

millimeters. At the centre of the semicircle was pivoted an arm carrying a brushholder in which was a steel spring. The brushholder was so adjusted that the revolving knife edge made contact with the spring several times per second. The arm carrying this spring could be clamped wherever desired, and its position designated by means of a pointer over the scale.[2] Thus, the condenser, placed in series, could be brought to the same difference of potential that existed between the spring and the knife edge. The arc circuit was, as shown by the diagram of connections, Fig. 1, taken from one brush directly to a Westinghouse ammeter through a switch, by means of which a Thomson balance, or gravity ammeter could be put in circuit when desired. From the Westing-

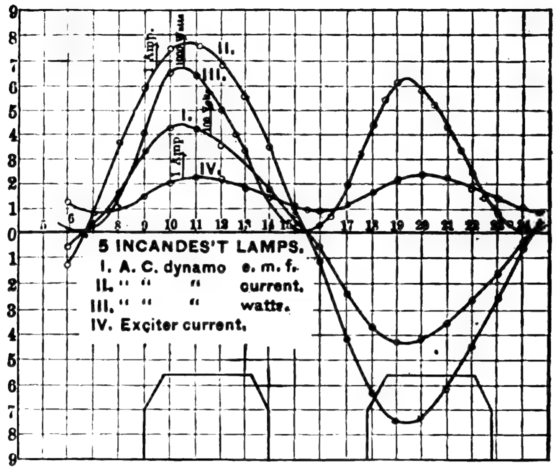


Fig. 3.

house ammeter the current was taken through the non-inductive resistance to the dynamo short circuiting switch, where the other terminal of the machine was directly connected. The exciter current was measured by a Ryan gravity ammeter, and a Hartmann and Braun type voltmeter indicated the potential around the terminals of the field. The arm of the commutating device being clamped at some desired position, the spring was adjusted so that the revolving knife edge made contact, then the switch was thrown on any one of the three pairs of terminals, for the circuits of which we wished to obtain instantaneous values. The half microfarad condenser was so connected that by closing a key it would be charged. Opening this key and closing one in

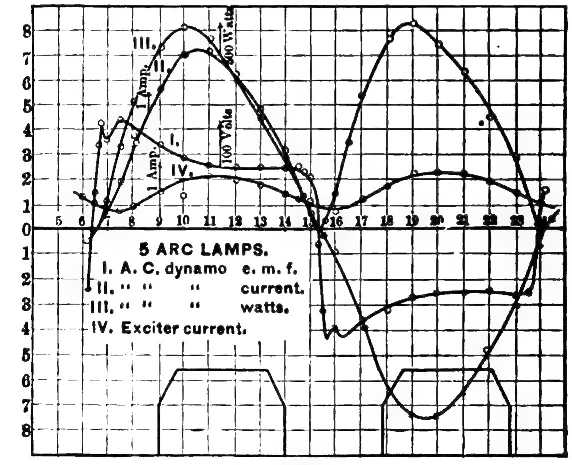


Fig. 4.

circuit with the galvanometer sent the charge through the galvanometer and the throw was noted.

The galvanometer used was of 5000 ohms resistance, and consisted of the coil of a Sir Wm. Thomson marine galvanometer, in which was suspended a small, concave mirror, having several very small magnets constituting the needle fastened on the back. The controller was a large horse shoe magnet. A simple wooden frame supported the coil. A narrow slit in a screen, behind which stood an incandescent lamp, allowed an image of part of the filament to fall on the galvanometer mirror and be reflected back to the screen, on which was a graduated scale. By placing a resistance box in shunt around the galvanometer, the throw of the needle was reduced when it was desired to read the arc E. M. F.

2. Much trouble experienced by other investigators in this line, due to breaking of the spring, was entirely obviated by us by putting a piece of thin rubber packing above the spring where it was clamped in the brushholder.

When current readings were taken the whole charge of the condenser was passed through the galvanometer. The galvanometer was calibrated for E. M. F. by putting the condenser and a standard potential instrument in multiple around the terminals of a storage battery giving about 120 volts. Readings were then taken of the voltage, and the corresponding throw of the needle was noted. The calibrations for currents were made by running the exciter alone and passing the current through both of the non-inductive resistances, determining its amount by an ammeter, and observing the corresponding throw of the galvanometer needle for each non-inductive resistance.

So much for a description of the dynamo, the instruments and the methods used. We now come to that which is of most interest, viz., the results obtained. In order that the curves may be more easily followed we will give a brief general explanation of them.

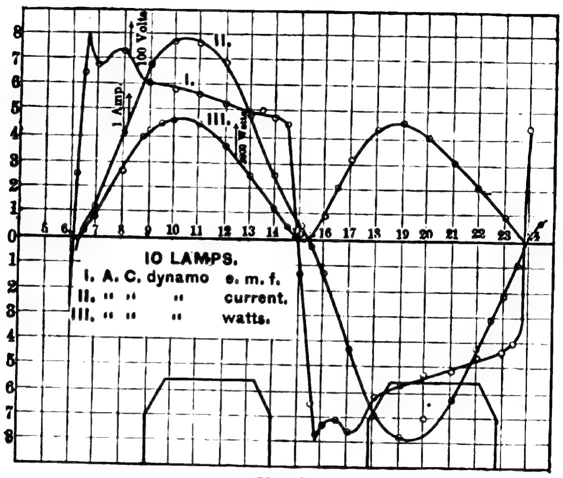


Fig. 5.

The figures on the zero line, always commencing with 5, correspond to the divisions on the scale of the wooden semi-circle, a part of the commutating device. Under each plate of curves will be seen two rectangular figures, representing pole pieces, which show the relative position of the curves with respect to the poles. From each curve projects a vertical arrow, always equal to one or two divisions, and its value marked near it. In all curves the direction of motion of the armature relatively to the poles is from left to right.

Fig. 2 represents the performance of the machine at short circuit.

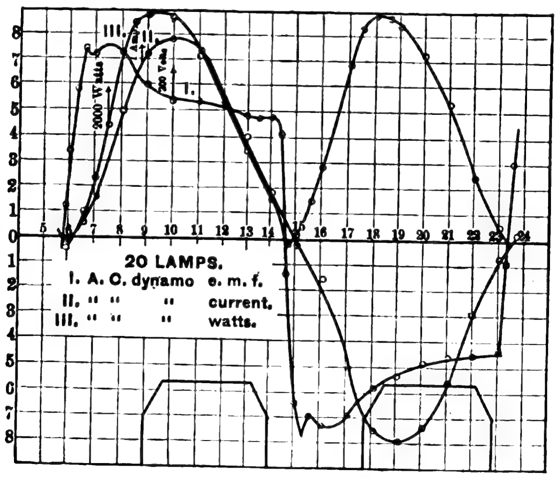


Fig. 6.

The curves of E. M. F. and current both approach sine curves; the current rising almost in unison with the E. M. F., there being no perceptible lag. The curve of exciter current in this, as in all cases, exhibits a wavy form. Fig. 12 shows the position of the amature relatively to the poles when the E. M. F. is zero and the machine running on short circuit.

Fig. 4, representing the curves for a load of five arc lamps, shows a radical change in the E. M. F., which now approaches more nearly to the form of a rectangle than a sine curve, and immediately after passing the zeros exhibits very sharp peaks. In this case the current continues to rise after the E. M. F. has begun to fall, and also lags slightly with respect to it. A shifting of the zeros has also taken place. Comparing this E. M. F. curve with that for short circuit it is seen that the first zero shown occurs at about 6.35 instead of 6.85. The curves for all loads of arc lamps are quite similar in form, as will be seen by referring to Figs. 5, 6, 7 and 8. As the load is increased, however, the zeros occur earlier with respect to the poles, and the current lag increases slightly. The efficiency curve, Fig. 9, tells the story of the dynamo from a commercial point of view, reaching as it does an efficiency of between 93 per cent. and 94 per cent. at full load while at half load it is 92 per cent.

A most interesting set of curves is shown in Fig. 10, giving a comparison of the forms and values of E. M. F. for 40, 30, 20, and 10 lamps, their position with respect to the poles, and also the position of the zeros of E. M. F. at short circuit.

Figs. 13 and 12 show respectively the positions of the armature relatively to the poles for full load and short circuit.

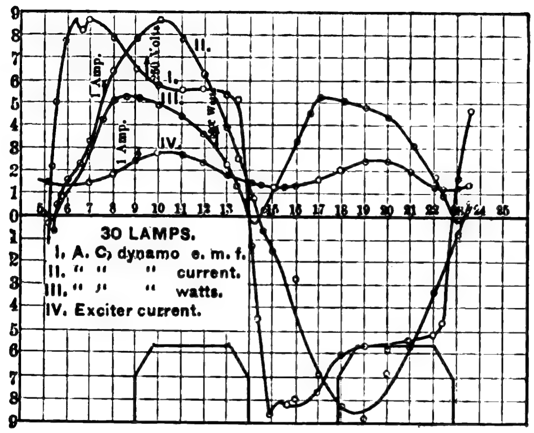


Fig. 7.

An apparently remarkable feature of the machine is that it may be short circuited when running at full load, without the slightest injury, and it may be run at short circuit indefinitely. That the machine regulates with great rapidity is proven by the fact that upon short circuiting it, the ammeter indicates but a slight increase of current. The peculiar form of the E. M. F. curve for arc lamps led us, so far as time would permit, to an investigation of the cause, to ascertain which the following runs were taken:

First, with a non-inductive resistance of five large incandescent lamps, but no arcs in circuit; each lamp consuming about the same amount of energy as an arc lamp. Second, with nothing but an inductive resistance, consisting of a solenoid having 440 turns of No. 10 wire. The curves in both cases were similar and approached sine curves, proving the rectangular form to be

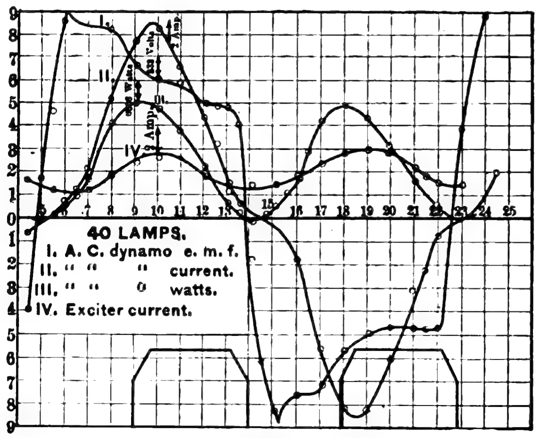


Fig. 8.

due entirely to the action of the arc. Fig. 3 shows the curves obtained from the load of incandescent lamps. To more fully determine this action with no other resistance in circuit, an arrangement was made whereby an arc could be regulated by hand with the aid of a hot wire voltmeter. We took no curve for a single lamp under normal conditions with which to compare the one taken in the above manner; but the latter (see Fig. 11) has very high and abrupt elevations of E. M. F. immediately before and after passing the zeros. The theory advanced to explain the high point of E. M. F. in all the arc curves is, that when the arc breaks, the rush of cold air adding resistance to the circuit, prevents the arc forming again until the potential has risen to a point considerably higher than that required to maintain an arc

once formed. To test this we attempted to heat an arc by means of an alcohol blast, and thus prevent, in a measure, the rush of cold air. This means of heating proved inadequate, so that the results were not all that could be desired. As before stated, we had no one-lamp curve with which to compare it, but as compared with the one lamp regulated by hand, the sharp

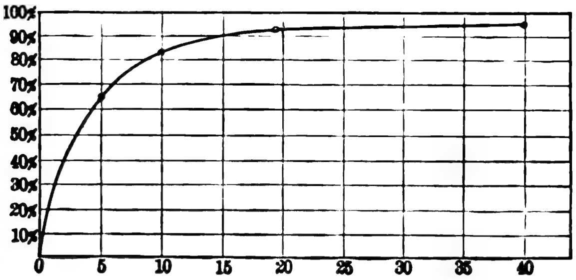


Fig. 9.—EFFICIENCY CURVE.

corners of E. M. F. were much modified. It is not certain, however, whether this was due to the action of the lamp regulating coils, or to the action of the flame. The current curve in all cases approaches a sine curve in form, but is always slightly steeper on the left or front side; direction of rotation being from left to right. Although the current lag is practically nothing at short circuit, or for any load except arc lamps, it increases slowly as arc lamps are added. For 40 lamps it is about 4½ per cent. of the time of an alternation. The wavy form of the exciter current is probably caused by the variable resistance of the magnetic circuit, due to the projecting cores and lugs of the armature as they approach and recede from the poles. The values of E. M. F. and

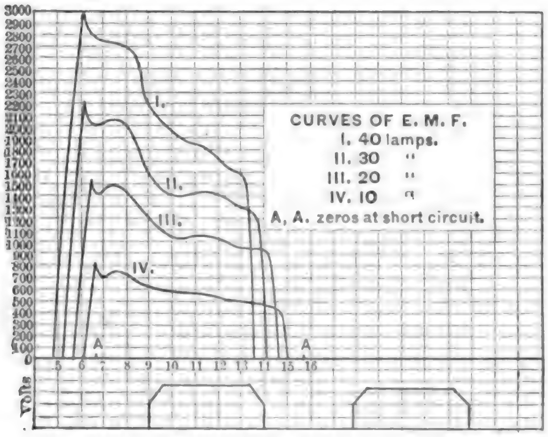


Fig. 10.

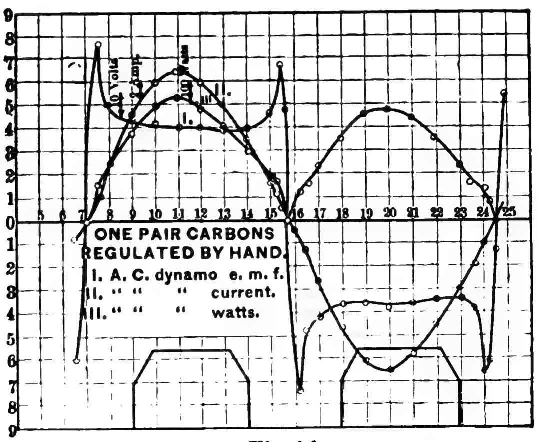


Fig. 11.

current were found by taking the square root of the mean square of 36 ordinates of a curve, representing a complete cycle. Although the current lag was very small, the product of the values of current and E. M. F. obtained as above did not give the watts. The watts were obtained by plotting a curve, the points of which were the products of the instantaneous values of E. M. F. and current; then integrating by a planimeter. Dividing the value of the watts thus obtained by the current, we obtained a value of the E. M. F. which was usually about seven volts lower per lamp than the corresponding value obtained from the square root of the mean square. This difference was no doubt due to the extremely high values of the E. M. F. when the current was very low, as the negative work was negligible. To distinguish between the two values we have called the one obtained from the square root of the mean square, the "actual" E. M. F. while the one obtained by the second method has been called the "effective" E. M. F., it alone being effective in doing work on the circuit.

It is very much of a question in our minds as to whether the square root of the mean square, obtained from the rectangular E. M. F. curves for arc lamps, gives the actual E. M. F., but for the lack of a better term the values thus obtained have been called the "actual" E. M. F's.

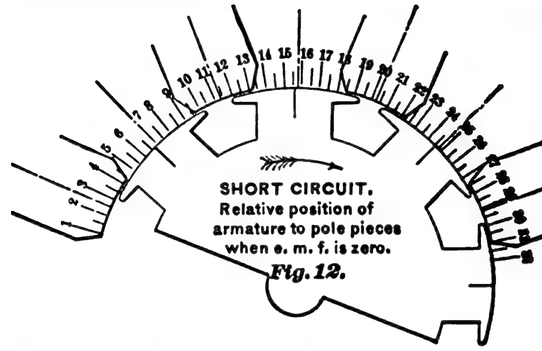


Fig. 12.

For arc current values we have assumed the square root of the mean square to be correct, and if not actually the case, they are certainly very close approximations, as the current curves are practically sine curves. The exact values of E. M. F. or current are of little consequence, however, except as a matter of interest, since the electrical output in watts is known, this alone being required to determine the efficiency.

In conclusion we can simply state that our investigations have shown, that the dynamo, aside from being very efficient and of most excellent regulation, is, as stated at the beginning, an extremely novel and interesting type of machine.

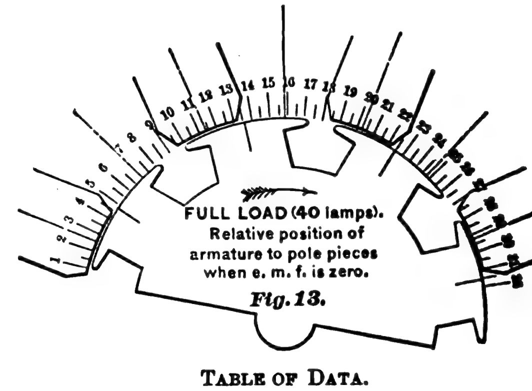


Fig. 13.

TABLE OF DATA.

	√Mean sq. of E. M. F.	Volts per lamp "Actual."	√Mean sq. of Current.	Volts per lamp "effective."	Mean Watts electrical.	Watts excitation.	Mean Watts by dynamometer.	Efficiency.
Short Circt.	3.53		9.78		35	155	1780	
5 Incandes.	289.	57.8	10.32	59.3	3060	158	3900	75.3%
5 Arc.	285.	57.	9.98	50.	2500	165	3584	66.6%
10 Arc.			10.7	53.3	5700	190	6630	83.5%
20 Arc.	1100	55.	10.36	48.3	10000	190	10680	92.3%
30 Arc.						204	12120	
40 Arc.			9.82	41.	16000	240	16950	93.2%
1 pr. carbns.	42	42.	8.86	35.5	314			

THE NATIONAL ELECTRIC LIGHTING SYSTEM.

Mr. L. N. Cox, of Washington, D. C., the Southeastern agent of the National Electric Manufacturing Co., of Eau Claire, Wis., reports having closed contracts for electric light plants at Newberry, S. C., for the Newberry Oil Mills; a central station for Chester, S. C., and a central station for Tarboro, N. C., where also he will put in a street railway and an ice factory.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.
Anonymous communications cannot be noticed.
The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.
In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.
Sketches and drawings for illustrations should be on separate pieces of paper.
All communications should be addressed EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

TRANSFORMER EFFICIENCY.

[144.] In your last issue I see from Mr. Swinburne's answer to my criticism in the issue of Sept. 6 of your paper, that he accepts my statement, "that the maximum value of the primary current in a transformer must occur before the impressed E. M. F. reaches zero, and this the more, the more load is thrown upon the transformer."

But I can not yet fully agree with Mr. Swinburne that for open secondary circuit this difference of phase is vanishingly small. For an ideal transformer indeed, that is, a transformer which wastes no energy at all in the iron, the energy consumed by the primary current would be rather small for no load, and therefore the difference of phase in this case negligible. For instance, in the transformer tested by Prof. Ryan this energy amounts to .4 watt; therefore, considerably greater than the .05 watt Mr. Swinburne suggests.

But in the same transformer the primary current expends 95.7 watts for the reversals of magnetism in the iron, and, if we assume as a very rough approximation—but one which will give us a fair idea of the operations going on—the work consumed by hysteresis to follow the sine-law, too, then we would have to expect, because of hysteresis, a shifting of phase given by the equation:

$EC \cos \omega = 96.1$ watts,

where, $E = 1030 =$ the primary E. M. F.

$C = .147 =$ the primary current.

Therefore the angle of shifting phase:

$\cos \omega = .635;$

angle $\omega = 50$ degrees,

and the maximum value of the primary current, if following the sine-law, would have to occur about 40 degrees before the impressed E. M. F. reaches zero, below a potential of about 900 volts.

Though this is only a very rough approximation, it is fairly well shown in the diagrams referred to. Such an angle of 40 degrees I can not allow to be negligible.

I am very glad to corroborate Mr. Swinburne's second remark, that the whole discussion was produced only by a mutual misunderstanding.

As it was said in those papers that the secondary current of the transformer gives back energy to the primary circuit, it was certainly not meant that this energy was stored up in the secondary circuit as electrostatic charge, as Mr. Swinburne suggests, but the term "current" was used with the meaning modern science attributes to it, not only considering what is going on inside of the wire, but also including the electro-magnetic disturbance outside of the wire, that is, the magnetic field of the secondary current; and it is this magnetism, which stores up and gives back energy to the primary circuit.

If it had been thought possible by the authors of those papers that somebody might misconstrue this, as Mr. Swinburne did, they very likely would have been more precise and would have put it perhaps like this:

"In the transformer there are three circuits, the primary electric circuit, the secondary electric circuit, and the magnetic iron circuit. During a part, greater or smaller according to the load, of each period the primary electric circuit gives off energy to the magnetic circuit, where it appears as potential energy of magnetism; during the other part of each period the magnetic circuit gives back energy to the primary circuit, in the form of an E. M. F. induced in the same direction as the instantaneous value of the primary current.

"The magnetic iron circuit transfers energy to the secondary circuit, either all the time, or, if there is self-induction in the secondary circuit, only during a part of each period; while during the other part of the period the secondary circuit gives back to the magnetic transformer circuit a part of its energy, which was stored up in the outside magnetic field, causing the self-induction.

"In regard to the electric transformer circuit, the magnetic transformer circuit during a certain part of each period must be considered as belonging to the primary electric circuit, during another part of the period to the secondary, and generally to both electric circuits.

"The transfer of energy from the primary electric circuit to the magnetic circuit, and back, has been plotted in these curves referred to."

That a magnetic field is capable of storing up a rather large amount of energy, is shown by numerical calculation.

Let $F =$ magnetomotive force, in ampere-turns,

Let $M =$ magnetism (number of lines of magnetic force).

Then the potential energy stored up in the magnetic circuit $F\,M$ is:

$$H = 10^{-8} \int_0^M F\,dM \text{ joule.}$$

where F and M are connected by the well known curve of magnetization:

$$M = \mathfrak{f}\,(F).$$

If for an approximation, we assume:

$$M = \frac{F}{R}$$

where R = const. = magnetic resistance (reluctance), then we get:

$$H = \frac{10^{-8}\,M^2}{2\,R} = 10^{-8}\frac{F\,M}{2} \text{ joule.}$$

In the transformer tested by Prof. Ryan, we have:

$M = 3850 \times 63.3 = 243700.$

$F = .21 \times 675 = 142.$

Therefore,

$H = .173$ joule,

transferred to and fro 550 times per second.

The last point Mr. Swinburne referred to in your last issue, I did not mention at all as an answer to his criticism, but only as a remark to Prof. Ryan's assumption, that the resistance of an incandescent lamp is dependent only on the effective current: it merely refers to an analytical treatment of this question, which proved that this assumption, though not absolutely true, can certainly be considered correct enough for all practical and also scientific researches. CHAS. STEINMETZ.

YONKERS, N. Y., OCT. 30.

SWINBURNE'S HEDGEHOG TRANSFORMER.

[145.]—I have read Mr. Tesla's article in your issue of the 24th ult. with great pleasure, and will, with your permission, deal with it point by point. First, he thinks it will be difficult for me to point to estimates of transformer efficiencies with the iron loss omitted. Prof. S. P. Thompson's book on dynamos is deservedly well known and appreciated. Mr. Tesla will find the efficiency of a transformer worked from copper loss only in the last edition. The efficiency given is 97.2 per cent. The question of loss in iron has only come prominently to the front within the last year or so. Some American makers are, I think, ahead of us in this matter.

Mr. Tesla thinks 10 per cent. loss in iron an excessive estimate. Nobody could doubt the absolute accuracy of a statement in a Westinghouse advertisement, so we have authority for saying that the efficiencies of the four leading American makers average below 90 per cent., and no doubt this loss is mostly in the iron.

If circuits can be arranged so that transformers are cut off when light is not wanted, the advantage of the Hedgehog form of open circuit transformer is not so great. I quite agree with Mr. Tesla about this. In many cases I think it would be well to use an automatic switch, which cuts the transformers out when not wanted. As I am pecuniarily interested both in the Hedgehog transformer and the drop switch, I may be biased, but I cannot be accused of partiality in saying that I do not think any of these methods is a real solution of the problem, and that transformers stuck about houses are only a makeshift, and in the future we must distribute at low pressure from substations.

Mr. Tesla goes on to say that according to my arguments a transformer could be made most efficient with no iron. This, uttered in jest, is true. The only drawback would be expense in copper, unless the frequency were enormous. This was mentioned in my British Association paper, last year. Mr. Tesla goes on to say that to reduce the loss in iron to one-tenth I must use one-tenth of the mass of iron, and the same induction. I agree with him. But he thinks that if you remove three sides of a closed iron circuit, leaving an open circuit, or simple core, that the iron is more strongly magnetized than before. This is obviously wrong; in fact, the removal of three sides and replacing by air increases the magnetic resistance of the circuit, if I may again use this unscientific analogy. As a matter of fact, the induction in the iron varies inversely as the cross section and frequency and directly as the electromotive force. The "magnetomotive force" adapts itself to produce the necessary induction. If Mr. Tesla will look up curves of loss by hysteresis he will find it does not vary as the square of the induction.

Mr. Tesla next argues that if you arrange, say, four 50 light hedgehogs in a square you get a closed iron circuit, and the exciting current goes down, so that the loss by it is reduced. This is so. The loss due to the exciting current is small, under two watts, so in the four transformers the saving is, say, eight watts. You thus get a closed circuit 200 light transformer with a higher efficiency than an open circuit 50 lighter. Replace it by an open

circuit 200 light transformer and you get a higher efficiency still. We are sending the Westinghouse Company a 50 lighter to test. This size has a full load efficiency of 96.75 per cent. The constant loss in it is 20.5 watts. Taking Mr. Tesla's loss of less than 6 per cent., say 5 per cent., in iron, the saving in a 50 lighter always on is more than 100 watts, say 100 watts. If no switch is used, this goes on all day. The cost may be taken at, say, 5 cents per 1,000 watt hours, or 12 cents a day; 12 cents a day amounts up to $44 a year, so the transformer would pay its first cost in less than two years. In a few weeks the Westinghouse advertisement will read: "It will pay you to throw away our converters and substitute the Hedgehog make."

I cannot be in error as to the motives for shortening the magnetic circuits in closed circuit transformers, as I have not mentioned it. I said that the closed circuit was adopted to reduce magnetic resistance. If Mr. Tesla will look up my British Association papers, last year and this year, he will find that I have at least given some attention to the design of closed circuit transformers, and to the qualities of different kinds of iron.

I am glad to hear Mr. Tesla was the first to advocate open circuit transformers. I have no such claim; Messrs. Gaulard and Gibbs were before me, and I have only worked out a particular form.

Some day I hope I may meet Mr. Tesla without a revolver and convert him.

J. SWINBURNE.

WIMBLEDON, ENGLAND, October 10, 1890.

CORRESPONDENCE.

BOSTON.

Electricity Supplanting Oil in Cambridge.—Electric Railway Pole and Wire Regulations.—The Electric Elevated Railway Plan.—The British Iron and Steel Institute in Boston.

THE Cambridge City Council last evening voted to substitute electric lights for the oil lamps now in use in the Belmont district and wards 1 and 4.

At a meeting of the Board of Alderman, an order was passed that the committee on rules report on the advisability of providing in the rules or standing regulations that all permits for the location of street railway tracks, the erection of poles or posts for electric wires, and the construction of underground conduits, that the rules shall contain a condition that the work must be completed during the municipal year; also that a public hearing on the same shall be given. A petition was received from the West End Company praying that it might be allowed to lay a double track from the terminus of its lines in Dorchester to Ashmont, and was referred to the committee on railroads. The following order, passed by the Board Aug. 18, was rescinded: That all permits for the erection of poles for the support of wires hereafter issued shall provide that such poles shall be of the "Providence" pattern. Alderman Wilson moved a reconsideration, and the question was assigned to the next meeting.

The West End Street Railway Company has removed its engineering department from the Milk street office to the central power station in Albany street.

The hearing by the street commissioners on the proposed extension of Harrison avenue to Summer street and Hawley street to Water street for the elevated railroad, was continued in the council chamber at city hall yesterday morning, the remonstrants having an opportunity to set forth all their objections, which were confined chiefly to the amount of property to be destroyed. The hearing was adjourned till Saturday, Nov. 1st.

The Thomson-Houston Electric Company had the pleasure this week of entertaining the members of the British Iron and Steel Institute, accompanied also by Mr. H. M. Massey, electrician to the Queen, in Boston and Lynn. Mr. G. W. Davenport accompanied the party from New York to Boston, and in this city they were joined by a representative number of gentlemen from the Thomson-Houston Company and escorted to Lynn, where they were shown through the factories of the Thomson-Houston Electric Company and the Thomson Electric Welding Company. Electric welding formed the chief thing of interest, and the visitors were shown in operation the process of welding bars, cables, chains, rings, tubes and shell projectiles. At noon lunch was served in the drafting room, after which the visitors returned to Boston, and special electric cars were provided to take them in a "rapid transit" trip to Chestnut hill. At 7:30 p. m. there was a banquet at the Vendome, and the diners were guests of the Thomson-Houston Company. Capt. Eugene Griffin, general manager of the street railway department of the Thomson-Houston works, presided. At his right was John Alleyn, at his left, Mayor Hart. The other gentlemen at the table of honor were: Prof. Thomson, Gen. Francis A. Walker, Prof. Geissler, of Germany, Mr. Hawksley, Edward Atkinson, H. A. Pevear, W. H. Massey and W. Duff Bruce.

Mr. Griffin spoke briefly, extending a hearty welcome to the visitors, and introduced Mayor Hart, who welcomed the visitors to Boston. Sir John Alleyn replied for the iron and steel men, and expressed his great satisfaction at what he had seen. Mr. Griffin introduced Prof. Elihu Thomson, and there was a hearty hand-clapping. Prof. Thomson spoke briefly of the progress of the science of electricity and its relation to iron and steel, and predicted that in 20 or 30 years perhaps electricity would operate nearly all the railroads.

Prof. Geissler also addressed the meeting in German.

BOSTON, MASS., Oct. 31, 1890.

ST. LOUIS.

New Electric Railway Work.—Double Carbon Lamp Suits.

THIS month witnessed the successful inauguration of electric power on the main line of the Lindell Railway Co. from Third street to Grand avenue, the route being Washington avenue, Fourteenth street, Gratiot street, out bound, and Papin street; in bound, Eighteenth street and Chauteau avenue to Grand avenue. The Vandeventer avenue section, a new road lately acquired by the Lindell Railway Co., is also in successful operation, and gives the Lindell Co. a direct line to the Fair Grounds. This section was completed and in operation in time to handle the immense crowds of visitors to the Fair, and proves to be a valuable acquisition to the Lindell Railway Co. This most successful inauguration of electric power is due to the thorough and unstinting financial policy carried out by Mr. Geo. D. Capen, president of the company. The remaining portion of the main line from Fourteenth and Washington avenue to Vanderventer avenue will be ready for operation as soon as the engines arrive and can be set up, everything else being in readiness and waiting.

The East St. Louis Electric Railway Co. are laying track and setting poles on Collinsville avenue and Broadway. The first section of the road to be put into operation will extend from the Levee to the National Stock Yards. Connections will be made with Wiggins ferry boats and also with the Bridge Electric Railway. A temporary power station is being fitted up at the old Thomson-Houston arc light station on the levee, which has been abandoned by the Municipal Electric Light Co. since it passed into their ownership. A permanent power station will be erected on ground adjacent to the Citizens' Electric Light Co.

The Belleville and East St. Louis Electric Railway have secured a controlling interest in the St. Clair County Turnpike Road and will construct an electric railway 14 miles in length from Belleville to East St. Louis. The route of the turnpike will be used throughout a greater part of the way.

In the suit of the Brush Electric Co. against the Municipal Electric Light and Power Co., for infringement of patents on double carbon arc lamps, the plaintiff has filed a motion for a preliminary injunction.

ST. LOUIS, Oct. 26th, 1890.

CHICAGO.

Electric Lighting in Hyde Park.—The Electric Fountain.—Electric Railway Work.

THE Hyde Park Thomson-Houston Electric Light Company have now begun to supply the residences in that neighborhood with incandescent lamps run from their newly built station located at Fifty-third street and Illinois Central Railroad. This is somewhat of a new departure, it being the first plant in Chicago constructed specially to furnish electric lights for illuminating residences. The residents of this beautiful and wealthy portion of the city, who have suffered so long with the wretched quality of the gas they have had to put up with, have now an opportunity of obtaining brilliant illumination without the accompanying disadvantages of gas, such as dirt, heat and danger from fire.

The concluding display for the season of the electric fountain at Lincoln Park took place last week and was witnessed by several thousand people. The immense column of water, with its ever-changing hues and possessing in turn all the colors of the rainbow, shot into the air for more than an hour to the extreme gratification of the onlookers. The display ended at 8:30 o'clock.

The South End Electric Railway has recently been incorporated with a capital of $100,000, by Charles E. Loss, F. B. Dyke and C. J. Wood. Mr. Charles E. Loss has been largely identified with the construction of street railways and has made a specialty of electric roads. Amongst others he built the electric road at Pullman, and the Calumet Electric Street Railway, now in operation between Ninety-fifth street and South Chicago via Stony Island avenue and Ninety-third street. This company now proposes to build a system of lines through the section of country west and north of Lake Calumet and operated by electricity.

The unanimous consent of the property owners of the frontage on Michigan avenue from Ninety-fifth to 116th streets, on Ninety-fifth street and Michigan avenue to Stony Island avenue and on 103rd, 111th and 115th streets, from Michigan avenue to Lake Calumet, has already been secured. An ordinance will be imme-

diately introduced in the council for a franchise to operate the electric system on the thoroughfares named. It is intended to connect the territory on the ridge with the Pullman electric lines at 115th, 111th, 103rd and Ninety-fifth streets, and also to connect at the latter with the Calumet electric street railroad for South Chicago.

A syndicate of Chicago and Hammond capitalists who have large interests in the Calumet River basin are contemplating an electric line connecting South Chicago, Hammond and East Chicago. It is stated that they have control of a new motor invented by Theodore M. Foote, of Boston, which will be used. The lines as projected will be built north on Homan street in Hammond, and will be extended north between Wolf Lake and Lake George to connect with the Ewing avenue line at South Chicago. Branch lines will be built on a number of streets in Hammond. A cross-line on Gostlin street will connect Hammond and East Chicago. The Hammond council have passed an ordinance giving the new company the necessary street franchises but under such conditions that it cannot be accepted till some changes are made. This railway when completed will be part of a chain of street railway lines, running from Chicago to the southern limits of Hammond.

CHICAGO, Oct. 31, 1890.

UNIVERSITY NOTES.

HARVARD.

The courses in electrical engineering open this fall with still larger attendance than last year; in fact, the introductory ones are almost overcrowded. Ever since electrical engineering was made a separate course instead of occupying a subordinate position in the department of mathematics and physics, there has been a marked increase in the number of students at the laboratory. There is also a constantly growing interest in the more abstruse courses of mathematics and physics. These courses have always stood high, and are becoming more and more popular, especially with graduate students.

During the summer vacation the heating and ventilating apparatus in Sever Hall have been looked over and improved, much to the gratification of the teachers and students who use the class rooms. Among the improvements is an electric regulator in each room, which shuts off the steam or lets it on, according as the temperature rises above or falls below 70°.

The students of Harvard have long suffered from the lack of a suitable reading room for evening use. The authorities do not dare to put lights into the present room on account of the risk of fire. So the students have formed a committee to canvass the whole college and alumni to raise $150,000 to $200,000 with which to build a fire-proof addition to the present library building. This new part will, of course, be lighted electrically, and can be used evenings.

The opening meeting of the Electric Club was held October 16. Seven new members were elected. Three more papers have been added to the club's library, *The Scientific American* and its Supplement and the *Elektrotechnische Zeitschrift*. G. T. P.

SIBLEY COLLEGE OF MECHANICAL AND ELECTRICAL ENGINEERING, CORNELL UNIVERSITY.

The non-resident lecturers for the ensuing year have been elected as follows:—Prof. Mendenhall, Prof. S. P. Langley, Alexander Graham Bell, W. A. Anthony, Captain R. W. Hunt, Mr. James Allen, Mr. Holloway, Eckley B. Coxe, Chas. E. Emery, Dr. C. B. Dudley, Prof. Elihu Thomson, F. J. Sprague, Mr. Rothwell and Mr. E. D. Leavitt.

At the last meeting of the University trustees, $50,000 was appropriated for new apparatus and machinery for Sibley College.

Prof. R. H. Thurston has been elected "membre correspondent" of the "Ecole Supérieure de l'Industrie Nationale," Paris, in recognition of his services to science in presenting to English speaking engineers the work of the elder Sadi Carnot.

The senior Electrical Society has elected officers as follows:—President, H. M. Willson; vice-president, W. E. Lindsay; secretary, E. E. Williams. At the last meeting an interesting address on "Practical Electric Work," was given by instructor Geo. W. Shepardson.

F. C. Perkins, '91, has been elected an associate member of the American Institute of Electrical Engineers.

Mr. Andrew Carnegie was present at the recent meeting of the University trustees.

Prof. Carpenter is soon to make a running test of a locomotive on the L. V. R. R.

W. A. Ballard, '93, is on the editorial staff of the *American Manufacturer and Iron Age*, Pittsburgh, Pa.

E. S. Bowen, '90, is engaged at Chicago with the firm of McIntosh, Seymour & Co.

F. F. Goodwin, '90, is with the Thomson Welding works, at Lynn, Mass.

S. G. P.

LEGAL NOTES.

THE CONSTITUTIONALITY OF THE ELECTRICAL EXECUTION LAW.

The first motion to secure final action from the Supreme Court of the United States on the question of the constitutionality of the New York electrical execution law was made in the Supreme Court, at Washington, on Oct. 27, in the case of the Japanese, Jugigo, under sentence of death in New York. It was moved that the case be advanced and set down for a speedy hearing.

The point raised in the case is that the Kemmler execution demonstrated that killing by electricity is a cruel and unusual punishment and as such is prohibited by the Constitution of the United States. The court took the papers.

THE BRAGG DEVICE FOR HITCHING UP FIRE HORSES.

At Indianapolis, Ind., on Oct. 29, Judge Gresham of the Federal court decided the suit of Walker & Olters, of Terre Haute, charging infringement of patent in the use of the Bragg fire alarm device. The invention consists of a gong and a contrivance that unfastens the halters of the horses and drops the harness upon them by electricity when an alarm is sounded.

Several years ago the plaintiffs purchased the right to make and use the device in a number of States, and sought to introduce it into a number of Fire Departments. The owners then discovered that, without authority from the patentee, the device was used by nearly every city in the Union having a paid Fire Department. Suit was entered in 1887 to enjoin the city of Terra Haute and to recover damages, and Judge Gresham to-day decided in favor of the plaintiffs. Suits will now be filed against every city in which the invention is used.

METAL AND SUPPLY MARKET.

CHANGES MADE BY THE TARIFF.

The changes in the tariff made by the McKinley bill will effect materials used in electrical interests as follows:

Aluminum, formerly free, increased to 15 per cent. ad valorem. It was proposed to make this much higher.

Brass bars or pigs, old, yellow metal fit only for remanufacture, no change.

Copper, ores, reduced from 2½ cents to 1½ cents.

Old copper for remanufacture, reduced from 3 cents to 1 cent a pound.

Copper in plates, bars or ingots, not manufactured, reduced from 4 cents to 1¼ cents.

Copper in rolled plates, rods, pipes, sheathing, remains at 35 per cent. ad valorem.

Lead remains practically unchanged.

Tin remains at 4 cents a pound.

Zinc in blocks or pigs is increased from 1½ cents to 1¾ cents a pound.

Old zinc, for remanufacture, increased from 1¼ to 1¾.

Chromic acid, 6 cents per pound instead of 15 per cent. ad valorem.

Bichromate of potash remains the same at 3 cents per pound.

Nickel, etc., per pound, 10 cents, reduced from 15 cents.

Electrotype plates remain at 25 per cent. ad valorem.

Thin blown glass is increased to 60 per cent. ad valorem, from 45 per cent.

Mica is raised from the free list to 35 per cent. ad valorem.

Blue vitriol or sulphate of copper reduced from 3 cents to 2 cents.

Sal-ammoniac changed from 10 per cent. ad valorem to ¾ cents specific.

Sal-soda and soda ash remain at ¼ cent.

Caustic soda has been reduced from 1½ cents to 1 cent.

Sulphuric acid is increased from free to ¼ cent a pound.

Wire and wire rods are reduced ¼ cent a pound, where they are not covered. Where they are covered with cotton, silk or the like, they are increased 1 cent a pound. Flat steel wire is increased from 45 to 50 per cent. ad valorem.

The schedule shows that of the articles mentioned the tariff on 44 per cent. has been reduced materially, while it has been increased on 28 per cent. and unchanged on 28 per cent.

Parts made of porcelain, such as switch bases, socket details, etc., promise to be dearer, and the manufacturers in this country are likely to have a large amount of business thrown into their hands. It is claimed that the German article will practically be excluded from the market.

It is also claimed that a stimulus will be given by the tariff to the manufacture of fine instruments.

The general belief even among the many opposed to a higher tariff is that the springing up of many new factories and shops requiring electric light and power will have a good effect on electrical industries.

TRADE. NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT

THE NASSAU CAPSULE BATTERY, THERMOMETER AND BELL OUTFIT.

A CONVENIENT source of current for the numerous purposes to which electricity can be applied in the household, goes far towards popularizing and hastening the introduction of many important devices tending to health and comfort. To meet this demand,

FIG. 3.—NASSAU BATTERY AND BELL OUTFIT.

there has recently been brought out by the Nassau Electrical Co., of this city, a neat little chloride of silver cell, which is shown in actual size in the accompanying engraving. The zinc case acts at the same time as one electrode and from the centre projects a silver wire constituting the other electrode. The case is filled with the exciting electrolyte in the form of a jelly and the whole is hermetically sealed.

The cell so constituted can evidently be placed in any position and connected directly with the terminals of an apparatus without running an inch of wire.

One of the applications to which it has been put is in connection with an alarm thermometer, shown in Fig. 2. The rising

FIGS. 1 AND 2.—NASSAU CAPSULE BATTERY AND ALARM THERMOMETER.

above, or falling of the temperature below, a certain point, closes a circuit and rings the bell and calls attention to the fact. The little cell is directly attached and when the alarm is not required the battery can be turned off by means of the switch shown.

Fig. 3 illustrates the application of the cell to a bell outfit. Here the cell is completely concealed in the case of the push button.

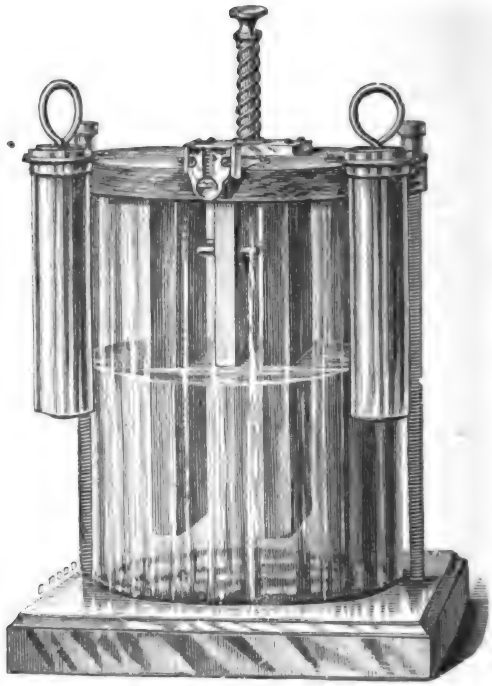
Numerous other application of a like nature will suggest themselves to our readers. The cell has an E. M. F. of over one volt, and gives over two amperes on short circuit. When worn out by continued use the cell can be withdrawn and replaced by a new one.

AN ELECTRIC CIGAR LIGHTER.

THE easy and cleanly manner in which light can be produced by the electric current makes the application of the latter preferable wherever it can be resorted to. A neat electric lighter for cigars, where dynamo current is not available, is that recently brought out by the Barr Electric M'f'g Co., of 17 and 19 Broadway, which is illustrated in the accompanying engraving. It consists of a single bichromate cell, the zinc element of which is fixed to a rod which passes through the cover and which is normally pushed upward by a spring so as to raise the zinc above the level of the fluid. By pressing the rod downward, the zinc is immersed, and the current established passes through a fine platinum wire, heating it to incandescence. A mere touch of the lighter ignites the alcohol at the tip.

A single charge of the chemicals, costing only five cents, is sufficient to afford 5,000 "lights" running from 30 to 60 days.

The arrangement has also been adapted as a domestic electric lighter by the addition of a small alcohol lamp, which, after being ignited, can be used as a torch, thus avoiding entirely the use of



THE BARR ELECTRIC CIGAR LIGHTER.

matches. Still another use to which the cell can be put is that of furnishing current for a domestic medical battery. Several other combinations, such as a cigar and domestic lighter, have also been constructed.

WESTINGHOUSE LIGHTING WORK.

The Brush Electric Light Company, of Baltimore, Md., has received the contract from the municipal authorities of that city to light the streets and public buildings for a period of five years. The contract calls for eight hundred arc lights and five thousand incandescent lamps. The Brush company operates the Westinghouse alternating current arc and incandescent systems of electric lighting.

The Westinghouse Electric and Manufacturing Company has concluded a very excellent record of contracts for the month of October. During the first three weeks of that month the company had orders for the furnishing of alternating current incandescent electric lighting apparatus approaching a capacity of 25,000 16 c. p. lamps. This is a very good showing in itself, though the contracts for arc light apparatus, street railway apparatus and electric mining appliances are not included in this.

Contracts for central station alternating current incandescent apparatus were received from the following places: Evanston, Ills., 750 lights; Baltimore, Md., 6,000; Elmira, N. Y., 1,500; Oswego, N. Y., 750; Durango, Col., 750; Lincoln, Neb., 1,500; Orange, N. J., 750; Uxbridge, Mass., 750; Tampa, Fla., 750; Cohoes, N. Y., 750; Manchester, N. H., 1,500; Amesbury, Mass., 500; Aransas Pass, Tex., 750; New Cumberland, W. Va., 750; Mason City, Ills., 500; Havana, Cuba, 750; Rich Holl, Mo., 750; Clearfield, Pa., 500.

Among the places where Westinghouse alternating current arc apparatus was installed during the month are: Oswego, N. Y., 60 lights; Clearfield, Pa., 25 lights; Washington, Pa., 60; Norwich, N. Y., 25; Baltimore, Md., 250.

THE U. S. ELECTRIC RAILWAYS CO.

The U. S. Electric Railways Co. is a new corporation that has recently been incorporated, and has established itself in comfortable quarters at 10 Wall street, N. Y. The company primarily is an engineering company, and will contract for and build electric railways, steam plants, power plants, and do all work connected with the complete installation of electric railways of any system. It will negotiate the sale of street railway bonds, and give special attention to the reorganizaton of street railway companies desiring to equip with electricity.

The president of the company is Mr. Wolstan R. Brown. Mr. W. L. Clark will act as their counsel, and Lemuel Wm. Serrell will be the general manager of the company.

The ability of the gentlemen associated together in this enterprise is well known to be the very best, their financial backing is solid and very strong, and we cannot but predict for them a very bright and prosperous future in the wide and important field of work they have undertaken. Mr. Serrell is particularly well known to our readers as a rising young electrical engineer, whose work in the stationary motor and electrical railway field has been of the highest class. He has made a specialty of power work for several years, and has published not a few valuable articles of a practical nature on various features of this great new department of applied electricity.

ELECTRIC EXHIBITS AT THE AMERICAN INSTITUTE FAIR.

The electrical exhibits this year, while not as numerous as in former years, owing no doubt to the many large exhibitions in different parts of the country which have taken the time and attention of exhibitors, nevertheless embrace a great deal that is of interest. The attendance this year has been up to that of former years.

The C. & C. Motor Co. exhibits a 50 light compound wound dynamo operated by a White & Middletown 8 horse-power gas engine.

The Chalmers Spence Co. show a full line of asbestos goods for all purposes.

The Safety Electric Construction Co , 45 and 47 Wall St., who control the Creamer automatic steam pump trap, have one in operation.

Clark Electric Co.—The exhibit of the Clark Electric Co., 192 Broadway, attracts considerable attention. They show a tasty stand on the main floor, which contains their arc regulator and automatic safety device for continuous and alternating currents. They also have an arc lamp in their ornamental fixture for interior lighting burning on a 110 volt incandescent circuit.

The D. Frisbie Co., 112 Liberty St., have an elevator, operated by their special elevator engine, which carries passengers to the top of the building.

Andrew P. Brown, 7 West Twenty-eighth St., shows his electric leak detector, an apparatus designed to give an alarm the moment an overflow of water occurs, thereby averting damage.

Kirkwood Grate Bar Co., 187 and 189 Mercer St., exhibit the Kirkwood patent shaking and dumping grate.

The Crosby Electric Co., 87 and 89 South Fifth avenue, have a very effective display of their well known dry battery. The numerous uses to which this battery can be put are shown by its operating a motor fan, lighting small incandescent lamps, and in telephone and burglar alarm work. They also have the Hussey blue stone battery.

New York Leather Belting Co., 84 and 86 Gold St., show a full line of their different kinds of belting.

The Metropolitan Electric Signal Co., 45 Broadway, exhibit their "Telecall" for use in factories, stores, banks, hotels, steamships, etc.

The Vulcan Smoke Preventing Patent Grate is shown by the Vulcan Manufacturing Co., of 47 Dey St.

Chas. A. Schieren & Co. show their perforated electric belt, and full line of belting material, for electric light plants, etc.

The American Link Belt Co. exhibit their link belt.

"Litofuge," the well known boilor compound, is in the corridor.

Himmer & Anderson show their dry battery and cigar lighter.

THE AFFAIRS OF THE HARRISBURG CAR COMPANY.

The special committee of five, Messrs J. Wister, S. C. Gilbert, G. M. McCauley, G. K. Reed and W. W. Card, have recommended that the Commonwealth Guarantee Trust and Safe Deposit Co., of Harrisburg, be appointed receiver for the Harrisburg Car Co. The Board of Directors has accepted the recommendations of the committee, and the plan will be duly carried into effect.

OTTO GAS ENGINES IN ELECTRIC LIGHTING.

Messrs. Schleicher, Schumm & Co., of Philadelphia, now have their hands full keeping even with their orders for gas engines, many of which are used for isolated plants and central station work. A number of instances have occurred in Philadelphia, where isolated plants using the Otto gas engine have been installed because of the inability of the parties to get service from the electric light companies—the municipal restrictions on overhead wires being the obstacle. It is a significant fact that the gas engine is coming into use more prominently since the custom of gas companies also running electric light plants has been in vogue, in which cases the superior economy of the "Otto" over a separate engine outfit shows up finely.

THE BABY ELECTRIX SWITCH.

We illustrate in the accompanying engraving, the "Baby" Electrix switch, which is just being brought out by the Star Elec-

The Baby Electrix Switch.

trix Co., Phila. It is about the smallest made and embodies all the excellent features of their larger 10 amp. switch. The contacts are of soft metal, wearing bright by use, and they are finished in fancy colors to match interior finish.

THE FITCHBURG STEAM ENGINE CO.

A fine steam plant installed at the Watervliet Arsenal, Troy, N. Y., by the Fitchburg Steam Engine Co. has just been started. The plant consists of one 250 h. p. duplex engine, three horizontal tubular double-riveted steel boilers, a feed water heater, a steam pump and an injector, together with various accessories. The engine consists of two horizontal variable automatic cut-off engines, arranged as a pair, with one shaft common to both. The cylinders are each 16¾x36 inches. The contract specified that the engine must develop not less than 250 horse-power, under 80 pounds of steam. The boilers are each of 100 horse-power. The trials have been a complete success.

FREDERICK PEARCE.

Mr. Frederick Pearce, successor to the old established house of Pearce & Jones, at 79 John street, N. Y., has now a scheme for inducing "Young America" to become interested in electricity, which promises to be successful. Mr. Pearce has taken a 6 c. p. Edison lamp, made up a little outfit for a small battery to light same—a battery lasting a couple of hours on continuous work—the whole being neatly packed and sold at such an attractively low figure as will fairly tempt the price from a student of electricity.

THE NATIONAL WIRE MANUFACTURERS.

The New York Insulated Wire Company, 649–651 Broadway, this city, have received an order for wire to be used in the Executive Mansion at Washington, D. C. As the company have also furnished the wire for the Statue of Liberty, the Washington Monument, the State, War and Navy Departments, they begin to feel that they are entitled to the name of the National Wire Manufacturers.

The Carnegie Music Hall, Fifty-seventh street and Seventh avenue, is now very nearly completed. It is a very attractive and imposing building, constructed principally of Milwaukee pressed brick. It is built from the plans of architect Wm. B. Tuthill, 52 Broadway. Chas. H. Davis is the engineer in charge. A feature of the Carnegie Music Hall will be the lighting arrangements. It will be lighted throughout with electricity, the Thomson-Houston system of electric lighting being employed. There will be 4,000 incandescent lamps. The wiring of the building for these lamps is to be done exclusively with the Grimshaw white core wire, manufactured by the New York Insulated Wire Company, at a cost of about $15,000. The new *World* building is wired almost entirely with the New York Insulated Wire Company's popular specialty.

ELECTRIC MOTORS IN PENNSYLVANIA MINES.

The Sumner Hill mines, at Woodville, Pa., have just been equipped with a complete electric plant of mining machinery. The power plant consists of one Westinghouse Junior engine, one 30 h. p. three-wire, four-pole Westinghouse alternate current generator, six Hercules coal mining machines, a twelve-foot fan with a capacity of 30,000 cubic feet per minute, centrifugal pump, etc. The mining machines and the pump are operated by 3 h. p. Tesla motors. The entire equipment has been furnished by the Westinghouse Electric and Manufacturing Company.

A careful record of the work of the mining machines in the Willock mine, which is also operated by Westinghouse electric mining appliances, shows that from July 1 until August 8, each cut represented about one and one-tenth tons of coal. It was found that it was impossible to keep the rooms cleaned up fast enough of the coal that was brought down, to give the machines a chance to test their full capacity. Each machine is doing the work of from twelve to fourteen pick miners.

THE CENTRAL ELECTRIC CO., CHICAGO.

The Central Electric Company's new fixture and electrolier department is now complete, and adds materially to the showy appearance of their already handsome store. This company are showing a piece of plain Okonite wire that was placed in the Lumber Exchange Building at Minneapolis five years ago, and has been used continuously ever since. The wire was stapled to the fire-proofing and plastered over, and is now apparently in as good condition as ever. Okonite seems to become more popular with architects and electric light men each year, and has so far withstood the severest tests that have been applied to it. The Central people have a stock of fully two million feet in their warerooms, and try to maintain it at about that figure as a reserve.

MR. EDISON EXPLOITING CANADIAN NICKEL MINES.

A special dispatch from Ottawa, Canada, of Oct. 29, says:—"Thomas A. Edison is the latest American who has turned his attention to the Sudbury nickel district. Officials of the Canadian Geological Survey state that the inventor will soon begin to develop mining properties adjacent to the mines owned by the Standard Oil Company. Mr. Samuel G. Burn, the expert sent out by Mr. Edison, was here a few days ago. It has transpired that the inventor has bonded thousands of acres near Sudbury on various sections. The outcropping of nickel is very promising. Mr. Burn confirmed the opinion of the Geological Survey that the Canadian nickel region is the richest mining district in the world. The Edison people claim to have discovered a process by which the nickel ore can be treated very inexpensively, leaving a larger margin of profit. The astonishing statement is made that every dollar invested in the mines brings a return of $4 profit per month. Mr. Burn has already examined various mica mines, the product of which will be utilized for electrical purposes.

EUREKA TEMPERED COPPER.

The Eureka Tempered Copper Co., of North East, Pa., have received the following from W. M. Ramsey, assistant superintendent Federal Street and Pleasant Valley Passenger Railway Co., Pittsburgh: "In reply to your inquiry concerning our experience with tempered copper, would say that, after a year's use, we can heartily endorse it, and recommend it for all descriptions of bearings and for electrical purposes, such as commutator bars, trolley wheels, etc., etc."

THE ELECTRIC CONSTRUCTION & REPAIR CO.,

205-207 Canal street, Chicago, will do general construction work, giving special attention to street railway construction. Several employés of the late well-known Sprague Electric Equipment Company have been retained for this department, and will be under the immediate charge of Mr. W. Sharpe, thereby ensuring good work and modern methods of construction. Mr. C. M. Barclay, who represented the Sprague Electric Railway & Motor Company for several years in Chicago and the West, and who also was secretary for the Sprague Electric Equipment Company, is the general manager, and Mr. W. A. Kreider, secretary, and his wide mechanical knowledge will be of great service to the company. Recognizing the difficulty street railway companies encounter in having repairs done in a prompt manner and at a reasonable cost, they have equipped a repair department where armatures and field coils of any system will be rewound or repaired. The repair department is under the management of Mr. J. G. Hart, who has had many years' experience, and whose work is well known.

The company has secured premises with power in the new Springer Building, 205 Canal street, corner of Jackson, facing the river, thus being situated in close proximity to the centre of the city, and the various railway depots.

J. G. BRILL'S ELECTRIC CARS.

The J. G. Brill Company, Philadelphia, is busy with orders for electric street railway cars and trucks. This company is equipping the Missouri street railway of St. Louis, the Toledo electric railway, of Toledo, O., the Ann Arbor street railway, of Ann Arbor, Mich., the Memphis electric railway, of Memphis, Tenn., and also equipping roads for Wilkesbarre, Pa., Syracuse, N. Y., and Cleveland, O., and is making six storage battery cars to be used in Dubuque, Ia., and five storage battery cars for the Electric Traction Company, of New Orleans, La., which are fitted with a system of handling battery trays from the ends of cars. A notable fact is that every order at the works at present is for electric street cars.

THE "UNIVERSAL" ARC LAMP FOR INCANDESCENT CIRCUITS.

The "Universal" Arc Lamp Co., of 16 and 18 Broad street, and 49 West 22nd street, where the lamps can be seen, are bringing out a line of arc lamps intended for direct current circuits. They give a steady, noiseless light of great purity, and can be adjusted for circuits having a pressure from 100 to 125 volts, using from 8 to 9 amperes. When burning two in series, the resistance is coiled around the chimney at the top of each lamp, within which the carbon rod is suspended, thereby rendering any additional resistance unnecessary.

The company have also brought out the "Universal" theatrical lamp, for stage purposes, knocking out the old calcium lamp very effectually, besides being easy and economical to run. Outfits are furnished, ready to operate, at the shortest notice.

"AJAX" SWITCHES FOR HEAVY CURRENTS.

Mr. C. S. Van Nuis, of 74 Cortlandt street, has just issued a very neat and handy little pamphlet on the subject of "Ajax" switches. It contains one of the best and pithiest discussions of the essential points in heavy current switches that we have ever seen, and we heartily endorse its remarks on current carrying and breaking capacity. Mr. Van Nuis has embodied in his switches not only great experience, but much reflection on cause and effect and remarkable ingenuity in the adaptation of means to ends; and the result is that he has already, in so short a time, made them a standard article in the market. It may be hoped and expected that he will continue his good work in this field, and even try his hand on one or two other details that still need attention in electrical lighting and power equipment.

LIGHTING THE BRIDGEPORT MACHINE TOOL WORKS.

E. P. Bullard, proprietor of the Bridgeport (Conn.) Machine Tool Works, has put an electric light plant into his works. It consists of a 35 horse power high-speed engine and a 380 incandescent Edison dynamo. The fly wheel of the engine connects by means of an Evans friction pulley direct with the dynamo. Mr. Bullard estimates that this plant, which cost him about $3,000, will save him $600 per year, over the use of gas. His works are very large and have only been fairly well lighted.

ST. PAUL TRADE NOTES.

THE ELECTRICAL ENGINEERING AND SUPPLY CO. has recently been formed with C. A. Daigh as president and general manager and Morgan Brooks, secretary and treasurer. The company has been laying in a stock of general supplies, and is now ready for business, having already received a number of orders.

THE WOODBURY, MERRILL, PATTEN AND WOODBURY AIR ENGINE.

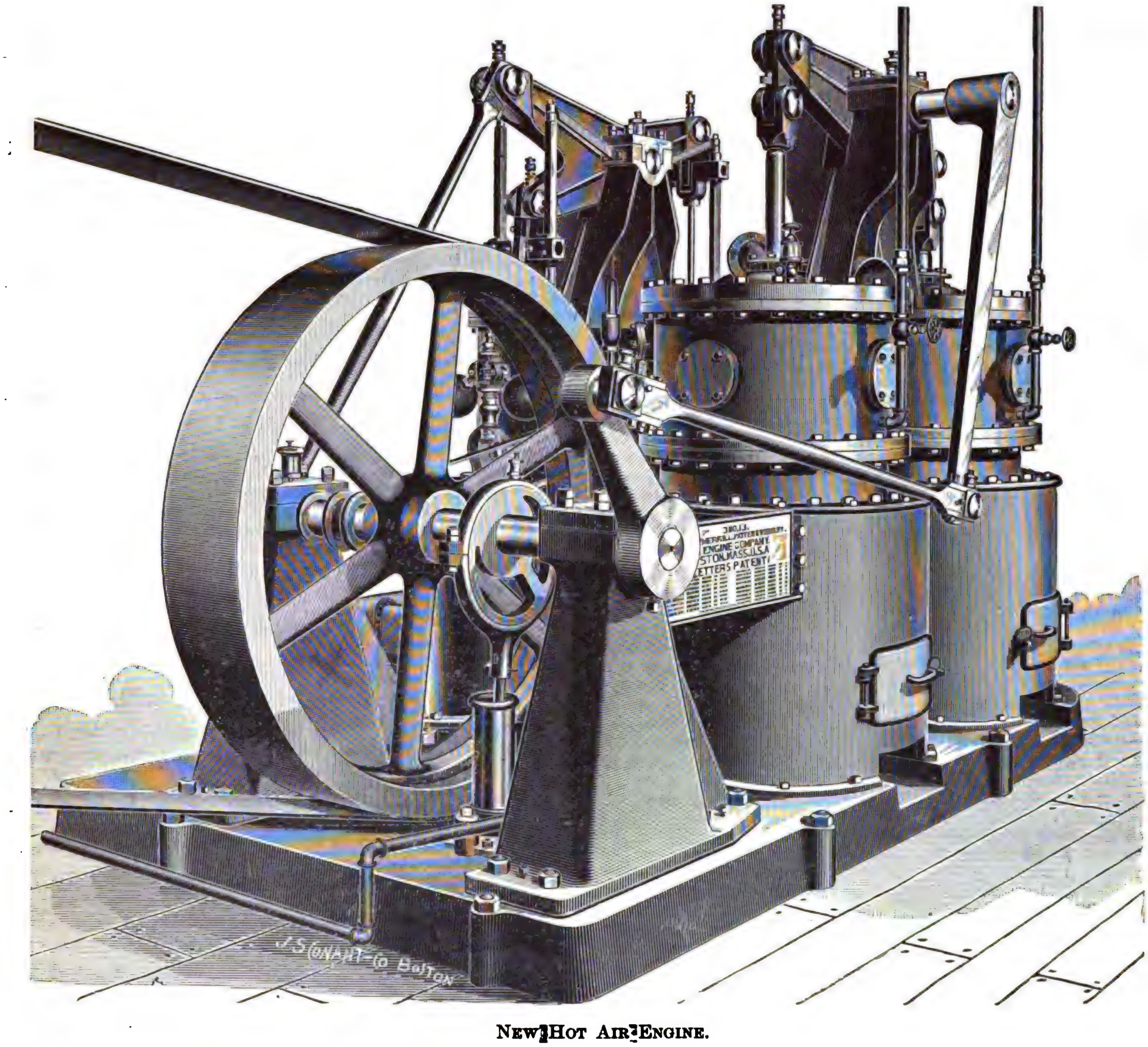
The high economy as well as the ease with which hot air engines can be operated, as compared with steam engines, has long made this type of prime mover the subject of study and experiment, but up to the present their construction has been limited to engines of but comparatively small powers. Indeed it may not be generally known that the great inventor, Ericsson, spent a large part of his time on the perfection of hot air engines, and that a large number of small engines of that type are in daily use for various purposes, such as pumping water, etc.

The application of the well known principles of thermo-dynamics to a hot air engine of larger power has, after a long series of experiments, led to the construction of the engine illustrated in the accompanying engraving, which is now built by the Woodbury, Merrill, Pattten and Woodbury Air Engine Co., of Boston. An engine of 10 h. p. is now on exhibition, driving blast fans and a lathe at the Fair of the Massachusetts Charitable Mechanics Association, and as it embodies a number of novel features, a description of it will be of interest to many of our readers using power.

The essential features of the engine are a heater, regenerator, and cooler, which three in combination are termed a reverser. The engine illustrated is composed of two reversers and two double acting working cylinders. It is not an exhausting engine; therefore, it has neither admission nor exhaust valves. Each reverser is provided with a reverser heater, placed within a furnace; a generator, composed of wire cloth of great superficial area, extending from the cooler to the bottom of the reverser heater; a cooler, composed of a large number of thin copper tubes, which are surrounded by water; and a displacer piston, having metallic packing rings, and adapted to reciprocate within the cooler.

In the operation, the alternate raising and lowering of the temperature of the same mass of air is accomplished as follows: In the upward stroke of the displacer piston, the mass of air in the cold chamber above the piston is forced, First, through the cooling tubes, in its downward passage, through which the temperature of the air is not materially changed. Second, the air enters the regenerator, and in its passage through the same it absorbs heat which has been imparted to the regenerator. Third, the air then passing over the heated surface of the reverser heater, thereby becoming further heated, enters the hot chamber below the displacer piston.

The temperature of the air in the cool chamber is about 120° F., and the temperature of the air in the hot chamber is about 600° F.



New Hot Air Engine.

In the downward stroke of the displacer piston, the mass of air is forced, First, to the regenerator. Second, the air enters the regenerator, and in its passage through the same, it deposits thereon the greater portion of its heat. Third, through the cooling tubes, where its temperature is reduced to about 120° F., and then into the cold chamber above the displacer piston. Therefore, at each upward and downward stroke of the displacer piston, the temperature of the same mass of air is alternately raised and lowered.

The alternate raising and lowering of the temperature of the displaced air (in both reversers) generates a power in accordance with the well-known laws of the expansion of gases, which power is developed by the working cylinders, as follows: While one displacer piston is making its upward stroke, and is heating and expanding the displaced air, thereby producing a pressure which is exerted against the bottom of the working piston of the working cylin-

der directly opposite the reverser, and against the top of the working piston of the working cylinder diagonally opposite; the other displacer piston is making its downward stroke, and is cooling and contracting the displaced air, thereby reducing the pressure against the bottom of the working piston, of the working cylinder directly opposite the reverser, and the top of the working piston of the working cylinder diagonally opposite. Thus each working piston is subjected to differential pressures, which are alternately reversed as the displaced air is alternately heated and cooled.

The engine is designed to run at an initial air pressure of 45 pounds and at a speed of 115 revolutions per minute. A test recently made by Mr. George H. Barrus, the well known engineer, showed a consumption of 1.54 pounds of coke per indicated h. p. per hour and 2.37 pounds per brake h. p. per hour.

We may add that a number of these engines have been in operation, one of them for several years, and that one of 35 h. p. is now in daily operation driving the machinery in the elevator and machine works of Messrs. Moore & Wyman, of South Boston. The effort is being made to introduce these engines for electric lighting purposes.

THE REGISTER AT THE "ELECTRIC EXCHANGE."

The register at Alexander, Barney & Chapin's Electric Exchange in the Telephone Building, 20 Cortlandt street, this city, shows a long list of visitors during the past week. Among the names appear those of:—E. H. Clark, Long Branch, N. J.; Rudolph Schmidt, Rochester, N. Y.; C. A. Nichols, Springfield, Mass.; J. Pinckney Smith, New Orleans, La.; A. D. Newton, Hartford, Conn.; M. E. Baird, Windsor, Conn.; W. C. McIntire, Philadelphia, Pa.; A. H. Hayes, Newark, N. J.; Romeyn Boyden, H. E. Harrington, Hartford, Conn.; J. F. Noonan, Paterson, N. J.; J. H. Shay, Chicago, Ill.; J. W. Packard, Warren, Ohio,; J. W. Peale, Wm. Whitney Munroe, O. S. Carr, Greenpoint; C. F. Pilen, New Jersey; Leo Daft, New Jersey; W. R. Eckart, San Francisco; George W. Davenport, Boston, Mass.; P. L. Saltonstall, Boston, Mass.; Wm. H. Temple, Fred. H. Whipple, Geo. W. Adams, Boston, Mass.; W. R. Bennett, Hoboken, N. J.; J. H. Bunnell, C. R. Huntley, Buffalo, N. Y.; Wm. M. Brock, Paterson, N. J.; Frank Wheaton, Paterson, N. J.

The firm have just secured the valuable services of Mr. David Chalmers, whose long experience in the electrical supply business and large circle of acquaintance, renders him a very desirable acquisition. He has already entered upon his new duties.

WESTERN TRADE NOTES.

The Electric Merchandise Company, of Chicago, have issued a very complete supplement to their regular catalogue containing handsome illustrations, descriptive matter, and prices of Sprague material for electric street railways. All the various adjuncts of the system, including axle brasses, armature bearings, motor and dynamo brushes and holders, pinions and gears commutators, fibre insulators, switches, etc., are tastefully arranged and their constructions clearly shown in the cuts. Parties operating the Sprague system should not fail to send for one of them.

The "Canvas Jacket" patent woven insulated wire, handled by The Illinois Electric Material Company, The Rookery, Chicago is enjoying a rapidly growing popularity amongst users of high grade moistureproof wire. Fresh testimonials are coming in fast, all in high terms of praise of its high insulation, resistance to abrasion and great toughness and tensile strength. The "Murray" overhead trolley switch is another meritorious specialty handled by the above company, and is meeting with approval by railroad men, and fresh orders are coming in all the time. The handsome souvenir pencils which they are giving away on application are rapidly vanishing, and those who have not already written for one should do so without delay.

The Great Western Electric Supply Company are just transferring their business to a new company of the same name but organized under the laws of the State of Illinois. Mr George Cutter, the able manager of the company, has sold out his interest to the new company, and will accept the managership of the new company, who are to be congratulated on this connection, as the immense business now being done by the company is almost entirely due to the untiring energy and perseverance of Mr. Cutter and to his large personal influence and widespread acquaintance amongst the electrical fraternity all over the country. His knowledge of the supply business and its many details is very extensive, and under his experienced management the greatest success is sure to accrue to any concern with which he is connected.

The Charles Munson Belting Co. are manufacturing a 60-inch belt for Akron, O., and a 48-inch one for Toledo, O., for the electric street railway plant. They are also making a 54-inch belt for Milwaukee, to be used for railway work.

The Knapp Electrical Works, Franklin street, Chicago, have just brought out a large and handsome catalogue of their numerous supplies and specialties. The book contains some 230 pages replete with fine cuts, ample space being allowed for each article and its accompanying reading matter to make a clear and prominent display. The famous Grimshaw white core and other wires and cables, connectors, cleats, pins, cross arms, railway supplies, insulators, rubber specialties, belts, fixtures, switches, lamps, sockets, annunciators, telegraph and testing instruments batteries and all kinds and classes of electrical supplies are prominently shown, and the whole arrangement of the apparatus is most complete and thorough, forming a fund of information which no purchasers of electric supplies should be without; and all should make early application for a copy.

The Central Electric Co. are to be congratulated upon the acquisition of Mr. George W. Vernor, who takes charge of the bookkeeping department. Mr. Vernor has been secretary of the Southern Electrical Supply Company, at St. Louis, for the past year, and is already well known to the electrical trade.

Mr. Charles E. Brown, of the Central Electric Co., has just returned from an extended trip of over eight weeks' duration. Mr. Brown reports business good, and brings home some nice orders for improved Candee wire.

Mr. James A. Lounsbury, so well and favorably known amongst the electrical fraternity of Chicago, as one of the managing engineers of the National Engineering Bureau, has severed his connection with the Bureau, to accept the position of electrician to the Thwing Electric Co., of this city.

Mr. W. H. Harding has been appointed manager of both the South Side Electric Light Co. and the Central Electric Light Co., of Chicago, and has his offices at 185 Dearborn street. The two companies operate the well known Ft. Wayne Electric Company's system. No better selection could have been made, as Mr. Harding is a man of immense executive ability in running a central station and thoroughly conversant with all the detail of this work.

Mr. W. C. Lyman, 49 Michigan street, Chicago, has just completed an enormous exhaust head for 20-inch exhaust pipe for the Chicago Edison Co. This is one of the largest ever constructed, and the mammoth exhaust head makes a most imposing show outside his shop.

J. Lang & Co., 44 Michigan street, Chicago, have put in two of their well known switches, each of 1,000 amperes for two new dynamos in the Chicago Edison Co's. station. They are also supplying the United Electric Traction Co. with all their large switches. Last week they shipped four 3-pole 250 ampere and six single pole 250 ampere to Bloomington. Ill., for street railway work.

Mr. James H. Garrett, one of the corps of engineers of the N. W. Thomson-Houston Co., who has been building the electric street railway in Streator, Ill., has resigned his position with the above company, and accepted a similar one with the Anaconda Smelting Co., of Anaconda, Mont.

NEW ENGLAND TRADE NOTES.

The Gethins Electrical Manufacturing Co. of Boston, manufacturers of the well known Gethins gravity cell, have become selling agents for the Sorley storage battery, and have become sole agents for their sale for phonograph purposes. Of late the Gethins company have been selling large quantities of the Gethins cells for charging storage batteries to run phonographs, and the New England Phonograph Company have adopted the cell for primary battery purposes.

The Standard Company of Vermont have sold a 500 light plant to the Worcester Woolen Mills, Worcester, Mass., and a 300 light plant to the Carolina Mills Company, Carolina, R. I.

The Bird and Sloane Electric Construction Co., of Boston, formerly Bird and Sloane, have been organized under the laws of the State of Maine, with a capital of $30,000, and have taken offices at 624 Atlantic avenue. Messrs. Bird and Sloane have been doing quite a large business in various electric construction work, and have taken this means to provide more capital for their increasing work. The officers of the company are:—Thomas J. Howe, president; Roswell P. Smith, secretary, and John F. Polsey, treasurer.

PHILADELPHIA TRADE NOTES.

Chadbourne, Hazelton & Co.—The Wenstrom Consolidated Dynamo and Motor Co., of Baltimore, made no mistake when they selected as their exclusive selling agents Messrs. Chadbourne, Hazelton & Co., of Philadelphia, who have recently so flooded the company with orders that something had to be done at once to meet the demand. At a recent meeting of the board of directors of the Wenstrom Company, in Baltimore, it was decided to rent a temporary factory at once pending the completion of the new factory now building. It is expected that the ew factory will be fully equipped in about three months.

THE
Electrical Engineer.

VOL. X. NOVEMBER 12, 1890. No. 132.

LIEUT. FISKE'S POSITION FINDER.

IN a recent issue[1] we described the valuable range finder of Lieut. Bradley A. Fiske, by which a gunner is enabled to know accurately the distance of the object which he is firing at. This instrument can be applied in many situations on land and on board ship, but

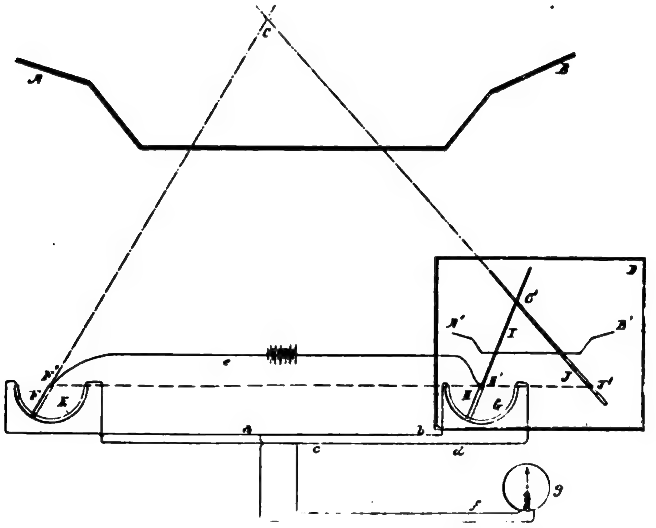


FIG. 1.—DIAGRAM OF FISKE POSITION FINDER.

presupposes, of course, that the gunner is able to sight directly upon his target. In modern fortifications, however, the tendency to the employment of what are known as disappearing carriages is becoming stronger every day and hundreds of such carriages are already employed in sea coast forts abroad.

In these forts the guns are loaded below the level of the parapet and when ready to fire are raised into firing position, usually by a hydraulic ram. This method of operation evidently protects those charged with the loading of the gun while the operation of loading is in progress; but it is evident, that by the means heretofore at hand, it has been impossible to sight the gun while depressed behind the parapet. True, the range could be determined beforehand by means of the range finder so as to permit the gun to be given the correct elevation before raising to fire, but this gives no indication of the true direction of the object to the concealed gunners, and hence deprives them of an essential factor in the pointing of the gun.

What was wanted, therefore, was some means by which the gunner could obtain both the range and direction of the object, with regard to the gun as a central point, in other words, their relative position. It is this which Lieut. Fiske has now accomplished, and in virtue of which the gunner is enabled to locate on a chart, drawn to scale, the exact position of a distant object which he has no means of seeing, but which is being sighted on by two observers placed at any distance, well protected from the fire of the enemy and unobscured by smoke.

The new position finder may be said to be a simplification and amplification of the range finder. It embodies, first, a telescope moving over an arc of conducting material and which is directed upon the distant object; second, a pivoted pointer moving over a like arc of conducting material in a Wheatstone bridge circuit with the first-named arc; the arrangement being such that when the alidade arm attached to the telescope on the first arc, and the pointer on the second arc stand at the same angle, the circuit is balanced. The pointer arm moves over a chart representing the area which includes the position of the distant object on a reduced scale. On this chart there is a simple pivoted arm which can be trained directly upon the object; or the arm may be mechanically controlled by a telescope directed upon the object so that it will make with the other arm an angle equal to that made by the lines of sight drawn from the two telescopes to the object. The position of the object is then shown by the intersection of the electrically directed pointer and the mechanically directed arm upon the chart.

In the accompanying illustrations, Fig. 1 is a diagram showing the general arrangement, and Fig. 4 is a similar diagram showing the chart D in different position. A B represents, for example, the parapet of a fortification. The distant object is supposed to be located at C; and it is the position of this object which is to be determined upon a chart D, on which the fortification line A′ B′ appears on a reduced scale. E is an arc of conducting material and F a telescope or arm pivoted at one end at F′ with its free extremity moving over, and making contact with, the arc E. G is an arc similar in all respects to the arc E and located in proximity to the chart D. H is an arm pivoted at H′ and having its free end sweeping over, and making contact with,

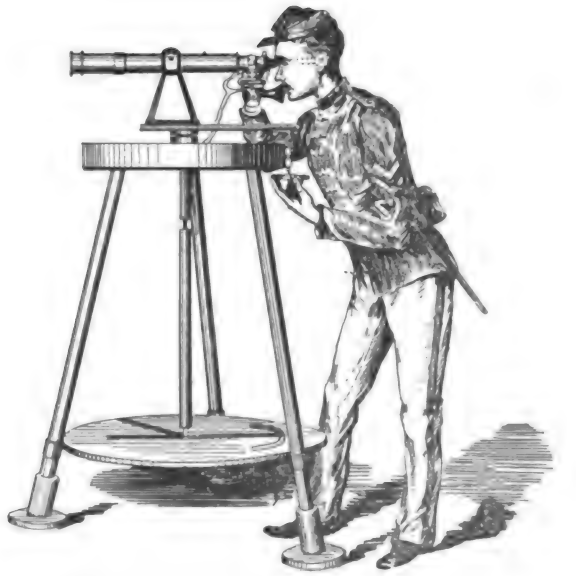


FIG. 2.—FISKE POSITION FINDER IN USE.

the arc G and carrying a pointer I. a, b, c, d, are members of a Wheatstone bridge connecting the arcs E and G. E is a loop including the battery, and *f* the loop including the galvanometer *g*.

Now it will be obvious that when the arm H is set upon its arc G at the same angle to the line H′ F′ as the arm F upon the arc E, then the bridge will balance and the gal-

1. THE ELECTRICAL ENGINEER, Oct. 1, 1890.

vanometer will indicate zero; and hence, inasmuch as the telescope F points to the actual object C, so the arm H will point to the corresponding position of the object C or C′ on the chart D. Pivoted upon the chart D at J′ is an arm J, which arm may be provided with a telescope or alidade, so that it may be directed upon the object C, the arm J being long enough to make intersection with the arm I.

If then the arm J is trained directly upon the object, inasmuch as the line H′ J′ joining the pivots of the arms I J on the chart D corresponds to the base line F′ J″ extending between the distant stations, and as the angle C′ H′ J′ equals the angle C F′ J′, it follows that the intersection of the arms I and J at C′ indicates the position of the object C upon the chart D. The chart being drawn to scale and laid off in divisions of known dimensions, it then becomes easy to

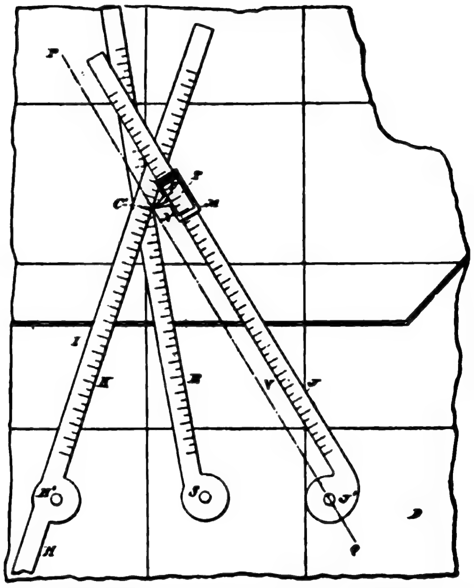


Fig. 3.—Intersecting Pointers, Fiske Position Finder.

recognize at a glance both the bearing and distance of the object C from any given point on the chart.

In actual practice Lieut. Fiske has adopted the form of apparatus represented in Fig. 2. This consists of a tripod supporting an upper platform which carries the standard upon which is pivoted the telescope. Extending downward through the platform is a shaft which turns with the telescope and standard. An arm is carried by the shaft and moves over a lower table on the upper surface of which is marked the chart. The arm is set parallel to the telescope; so that when the telescope is directed upon the object, the arm will also be directed upon the object. This parallelism of arm and telescope, however, is not essential. Carried upon the lower table is another arc and a second arm. The intersection of the two arms over the chart, as already explained, shows the position of the distant object; and the apparatus of Fig. 2, as indicated in Fig. 1, is located at one station, while the arc E with its telescope F is located at another distant station.

Referring now to Fig. 4, it will be seen that in this case the line H′ J′ on the chart D, while corresponding, as before, to the base line F′ J′, does not coincide with that line, and hence that the arm J is itself not directed upon the object. This represents the condition before referred to when the arm J is not set parallel to the axis of the telescope M, but at an angle thereto; this angle being such that the angle H′ C′ J′ will continue the same as the angle F′ C J′ despite a change in relative position of the chart D; such as indicated in Fig. 4.

In Fig. 3 is represented a construction of the intersecting arms I and J, which is especially adapted for the uses before detailed, and which allows of the actual intersecting point being determined with great accuracy. It will be obvious that with a chart laid out on a small scale and using arms I J of sufficient width or thickness to give them rigidity, the exact point of intersection of lines drawn through the pivot centres of the arms will be difficult to determine; and there may be considerable error in regarding the apex of any one of the four angles made by the intersecting arms as the true point indicated. In the device shown in Fig. 3, this source of error is practically eliminated; and in addition other advantages are secured.

The arm I has one edge K on a line passing through the pivot centre H′. On the arm J is a slide M, which carries a pointer N, projecting from the edge V; the extremity of this pointer being upon an imaginary line drawn through the pivot centre J′ and indicated by the dotted line P Q. It will be obvious that the point on the arm I indicated by the pointer N, will be the exact point of intersection of lines drawn through the pivot points H′ J′. The arms I, J are graduated lineally to conform to the scale of the chart D; so that the distance of the object from both separated stations can at once be read. Thus, on the rod I may be read the distance H C′ which is that of the object from the station at which is located the telescope F, Fig. 1; and on the rod J may be read the distance J′ C′, which is the distance of the object from the station at which is located the chart D. If it be desired to determine the distance of the object from any intermediate station between the two mentioned, a third pointer R may be placed in position between the two arms I J, and situated in the same relation thereto as the intermediate station is to the two extreme stations. The distance from the pivot point S of this arm to the point C′, the place of intersection of the edge of the arm with the point of contact of the edge K of arm I, and the apex of the pointer N, shows the distance of the object from the pivot point S, and hence from the intermediate station. The slide M is moved along by hand. It is provided with an opening T, through which the scale marks on the arm J may be read, and to allow this reading being

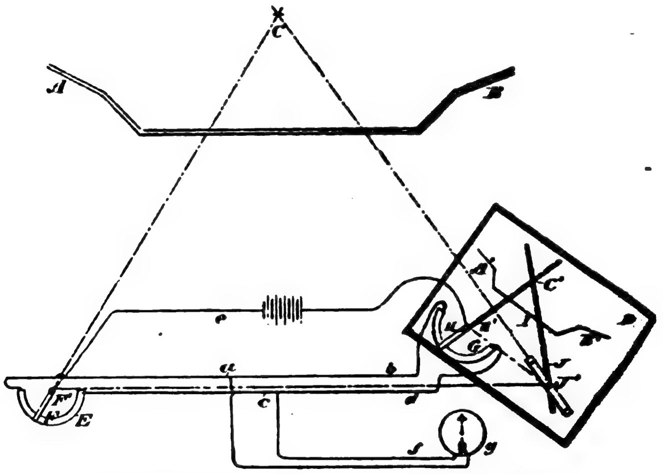


Fig. 4.—Diagram of Fiske Position Finder.

made, there is a central mark U made on the pointer N which comes into coincidence with any one of the scale marks.

Telephones are fitted to the telescopes in the same way as in Lieut. Fiske's range finder. This arrangement of telephone and telescope overcomes one great difficulty always found heretofore with observers widely distant from each other; that is, the difficulty of maintaining both lines of sight on the same point. This difficulty, when the target is partially covered with smoke, as in the case of a war-ship firing her guns, has been considered almost insurmountable, since the smoke would cover, at times, the very part of the ship at which the telescopes were directed. The telephones, however, enable two observers to agree instantly upon what point to direct their telescopes, and enable them to change the point as often as the circum-

stances of the battle require. The instruments are constructed of aluminum, bronze and iron, and require no care except an occasional cleaning.

Lieut. Fiske's position finder at Fort Hamilton, New York Harbor, has now been exposed to the elements for two months without any covering or protection of any kind. At a recent trial, the average error in determining the positions of objects distant between a mile and a quarter and three miles, was about one-third of one per cent.

BRADLEY'S SELF EXCITING GENERATOR.

In our last issue we described a type of machine designed by Mr. C. S. Bradley specially as an alternating motor, in which advantage is taken of a novel arrangement to obtain the torque reaction between field and armature. We are now enabled to describe another interesting machine of the same inventor, designed as a slow speed self exciting generator.

This machine, illustrated in the engraving, Fig. 1, may be considered to be a combination of Mr. Bradley's multipolar continuous current machine with an inductor of the same general type as the continuous current armature, the two being cross connected in a reverse manner, as shown in Fig. 2.

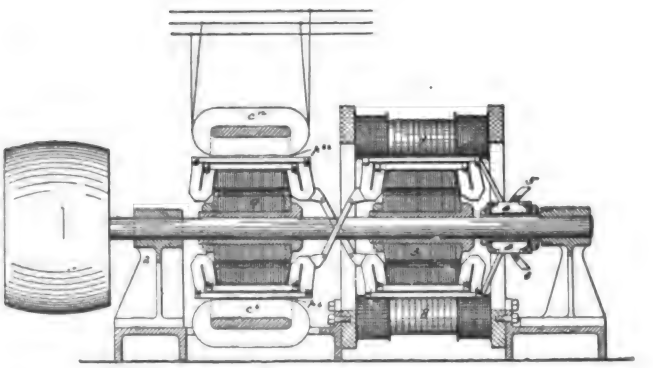


FIG. 1.—BRADLEY'S ALTERNATING GENERATOR AND MOTOR.

In the operation of such a machine, assuming the continuous current armature 3 to be driven in the direction indicated by the arrow on the pulley of the machine, current is induced in the winding of armature 3, and as the latter rotates while the polarity induced therein by the field remains stationary, it is evident that the polar lines thus set up in the armature-core travel, relatively, in a direction opposite to that of the movement of the armature itself. The connectors which are arranged between the armature 3 and the inductor 9 cause this rotation of the polar line which is now induced in the inductor 9 by the currents passing from armature 3 (owing to the reversal of one pair of the connectors), to change direction, and the propagation of the polar line now takes place in the same direction as that of the movement of the inductor itself. Consequently the actual speed of propagation of the polar lines in inductor 9 will take place at double the speed actually given the rotating shaft; that is, if the armature is rotated at the rate of five hundred per minute the polar line will traverse the body of the inductor 9 in the same direction at the rate of one thousand per minute.

Arranged around the inductor 9 is a stationary ring of laminated iron, the inner surface being notched, Fig. 3, and in the notches are wound the even number of coils, coils c c^2 c^3 c^4, etc., as shown in Fig. 4.

These coils may be connected to an external circuit in either of two ways, according to the character of alternating currents desired in the latter. They may either be connected all in series with the external circuit for a single alternating current, in which case the number of coils would be only one-half that shown in Fig. 4; or, as shown in Fig. 4, alternate coils may be connected in series and the terminals of each of the two circuits thus formed connected to the two external circuits 10 11 and 11 12. In the latter event the rotation of the polar line in the inductor 9 will set up in the two external circuits alternating currents with the phase of one-quarter of a period behind that of the other, so as to adapt the currents circulating in the external circuits for use in motors requiring currents of different phase. By suitably arranging the ring and its contained coils with reference to the number of poles in

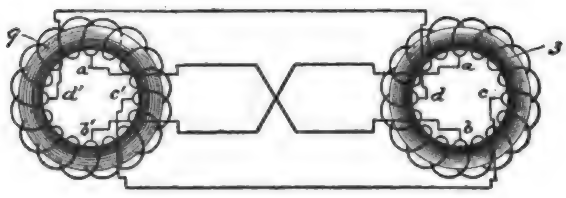
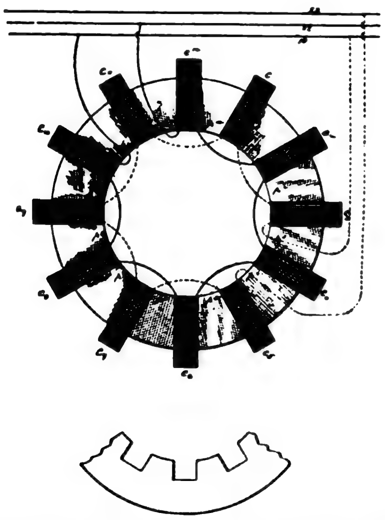


FIG. 2.—CROSS-CONNECTION OF ARMATURES.

the inductor 9 the difference of phase between the currents in the two external circuits may be caused to correspond with any desired lag.

Considered as a generator, Mr. Bradley claims that it has the advantage of producing rates of alternation at comparatively low rates of speed. In the machine illustrated, if the armature 3 rotates at one thousand revolutions per minute, the six poles in inductor 9 will rotate at the rate of two thousand per minute, and, the annulus having six coils in series, the external circuit will have produced therein six alternations for every revolution of the armature 9, the result being twelve thousand alternations per minute in the external circuit. Another advantage when the machine is used as a generator is the total absence of contact rings and brushes between the coils of the alternator and the



FIGS. 3 AND 4.—BRADLEY'S ALTERNATING GENERATOR.

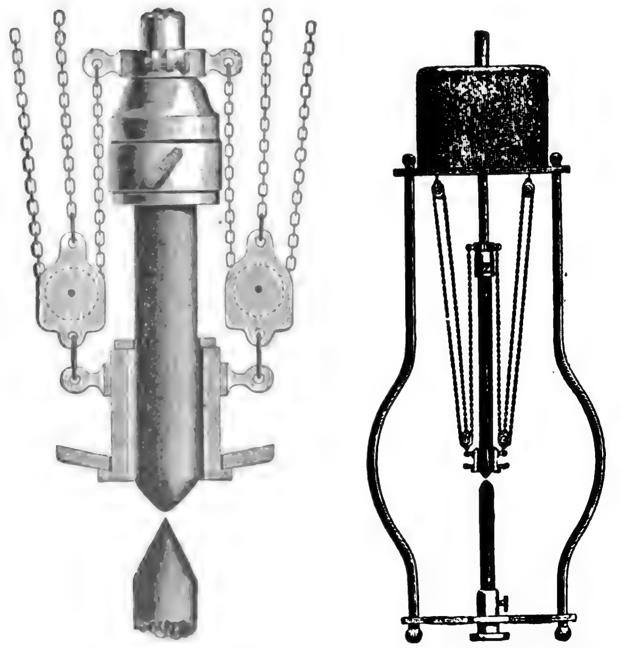
external circuit. Obviously the machine will operate as a motor when the coils c, c^2, etc., are supplied with alternating current from an external circuit.

BRITISH WEST INDIAN CABLES.

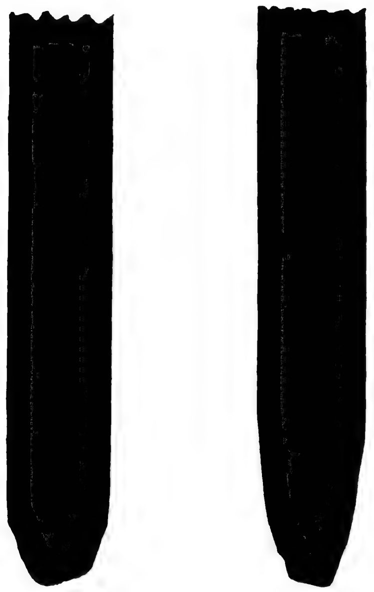
It is stated that in connection with new plans for fortifying the British West Indies, cable communications are to be established between all the islands. The ends of the cables in Jamaica, St. Lucia, and Bermuda will come into the forts. These cables will tap the main Halifax cable. They are under no conditions to connect with American wires.

THE HAZELTINE ARC LAMP CARBON SHIELD.

MANY of our readers readily recall the time when arc light carbons were sold at the rate of $1 a dozen and were not even then considered excessive in price. Since those pioneer days, there has been a continual diminution in the price of carbons, but with the enormous increase in the number of arc lamps burning nightly, the total expenditure involved amounts to many hundreds of thousands of dollars annually. It has, therefore, been the aim of many to increase as much as possible the life of the carbon on the one hand, or to increase its illuminating power with the same expenditure of electrical energy. These attempts have resulted in the application of various devices, either mechanical or as ingredients of the carbon itself, but, so far as we are aware, scarcely one of these methods has come into practical use, the pure carbon of to-day being still universally employed. The advent of a simple device by which an actual economy in the operation of the arc lamp is effected will, therefore, be of considerable interest, and for that reason we desire to call the attention of our readers to a simple and effective device of the kind due to Mr. W. B. Hazeltine, Jr., of the Hazeltine Electric Co., of St. Louis. This device, which is illustrated in the accompanying engravings, Figs. 1 and 2, consists simply of a sleeve of refractory material, forming a protective shield, or tip, which is freely suspended so as to hang in close proximity to the tip and the upper carbon close to the arc, the suspension device being so arranged that the sleeve is automatically maintained at its proper position near the arc. The effect of this simple arrangement, as has been shown by actual experience, is that the life of the carbon is practically doubled, so that an ordinary eight-hour carbon is able to burn 16 hours without retrimming. The exact action to which the saving in carbon and increase in life is due has not yet been fully analyzed, the fact remaining, however, as described. The shape of the carbon when protected by the shield is modified somewhat from that usually noted. Thus, in Fig. 4, is shown the tip of an ordinary positive carbon; and in Fig. 3, a tip which has been protected by the Hazeltine shield. It will be noted at once that the latter is considerably blunted, and the carbon shows a considerably larger crater than the unprotected one. The economical advantages gained by this device must be apparent. In the first place, not only may a large saving be effected in the carbon bills, but another important item, the cost of trimming lamps, may be reduced in almost the same ratio. A further attribute of the shield consists in the fact that it acts as an automatic cut-out whenever one or the other of the carbons is consumed, thereby preventing the destruction of the carbon holder, it being impossible, of course, for the holders to approach nearer to each other than the length of the shield. Aside from the economy in carbons and trimmer's services, it is pointed out that the convenience to customers of having their lamps trimmed every other day, instead of every day, as at present, will no doubt have the effect of increasing the popularity of the arc lamp. Besides, the consumption of the carbon is so complete that very little carbon dust settles at the bottom of the lamp, so that cleaning may also be deferred to the same time as trimming. We may add that the Hazeltine shield has been tested by Mr. James I. Ayer, superintendent of the Municipal Electric Light and Power Co., St. Louis, operating 3,000 lights, who, after a careful trial, fully corroborates the inventor's claims, which are also attested by the Western Electric Co., in whose factory a similar test was recently made under the supervision of Mr. C. A. Brown.



FIGS. 1 AND 2.—THE HAZELTINE ARC LAMP CARBON SHIELD.



FIGS. 3 AND 4.—CARBONS BURNED WITH AND WITHOUT HAZELTINE SHIELD.

FIVE-WIRE DISTRIBUTION.

THE five-wire central station at Königsberg, the first of its kind in Germany, will shortly come into operation. The total capacity of this station is at present 600 h. p. There are two groups of engines and dynamos, each comprising two triple-expansion engines, and four dynamos. The larger group which has to do the regular evening work consists of two 200 h. p. triple-expansion Schickau engines, each driving two 64 kilowatt dynamos. During the few hours of heaviest work, when two-thirds of the 8,000 lamps are alight, this group will be assisted by the smaller one, consisting of two 100 h. p. engines, each of which drives two 32 kilowatt dynamos. The fall of potential in the leads amounts to 10 volts at full load; the mains and distributing leads are all placed in Monnier conduits. The network is calculated for the supply of 24,000 lamps. Accumulators are used and special devices have been arranged to prevent them from being placed in the charging circuit before the right tension is reached. During their discharge, if their E. M. F. should fall, additional cells are automatically switched in. Any difference in the voltage of the different parts of the network is shown by a specially-constructed differential voltmeter.

THE MANUFACTURE OF KERITE INSULATED WIRE.

ONE of the first pioneers in the insulated wire industry, in this country, was Austin Goodyear Day. Mr. Day, who died but a short time since, was born at West Springfield, Mass., in 1824. Early in life he showed a decided bent for science and invention, and eagerly embraced the opportunity which was offered him, when he was only seventeen, of entering the India Rubber factory established by his cousin, Chas. Goodyear, at Woburn, near Boston.

Here he occupied a position as correspondent and bookkeeper, but with untiring industry he studied all the peculiarities of india rubber, devoting himself to the acquirement of an intimate knowledge of its physical and chemical properties, and the various processes of manufacture. At Woburn Mr. Day assisted at an important event in the history of rubber manufacture in this country, namely, the vulcanization of the first two or three yards treated by Hayward for Goodyear. He continued in Goodyear's service for several years, his strong bent for practical work securing him employment at various factories, at all of which he assisted greatly in perfecting the process of vulcanization. In 1851 he struck out for himself in an original line of investigation, and conducted a long series of experiments in the treatment of rubber with various materials, such as substitutes for magnesia, gums, resins and bituminous substances, and finally succeeded, by effecting a combination of rubber under the prolonged influence of a high degree of heat, in producing the first hard rubber made in this country.

A few years later, in 1853, Mr. Day made a great stride in improving the manufacture of rubber, and gave an immense impetus to the business by the invention and perfection of a process for cleaning the crude rubber. At that time Para rubber was the only kind used, as the rubber from other parts of the world was so much adulterated with foreign substances, dirt and impurities that its treatment could not be profitably undertaken. The price of Para rubber was so high that the development of the industry was necessarily hampered and restrained by the excessive cost of manufactured articles. Mr. Day's cleaning process rendered the treatment of impure or adulterated rubber a matter of ease; rubber from Africa, the East Indies and Central America then competed with the Brazilian product, and the cost of manufactured articles was reduced by about fifty per cent.

Fig. 4.—Exterior of Kerite Factory, Seymour, Conn., and a Corner of the Vulcanizing Room.

By 1854 Mr. Day had made so much progress in the industry to which he had devoted his energies that in that year he was enabled to buy a factory of his own, on the site of the present Kerite works at Seymour, Conn. By selling to the Boston Belting Company the rights to use his cleaning process he largely increased his capital, and was in a position to carry on the manufacture of hard rubber penholders and pencils as a business, while at the same time pursuing, with exhaustless vigor, his investigations and experiments in processes and combinations.

He applied himself with great earnestness to the perfection of the cleaning process, and for this and other reasons he postponed taking out patents for his inventions relating to hard rubber, as he wished to make them applicable to all kinds of commercial rubber, whereas without the cleaning process hard rubber could only be manufactured from pure gum brought from Brazil. Mr. Day's inventions had a very marked effect on the prices obtained for the different grades of rubber. In 1853 that produced in Africa and the East Indies sold for from 12 to 15 cents per pound, while the Para quality was quoted at from 30 to 40. So rapid was the rise in price, that before the cleaning process

FIG. 1.—AN EARLY STAGE IN MAKING KERITE.

had been very widely adopted Para rubber had advanced to from 75 cents to $1.00, and but for its introduction would have risen to $1.50. This great increase in price made an imperative necessity of what Mr. Day's cleaning process had only just rendered possible—the use of the cheaper grades—but so great was the demand for rubber goods that the price, even of these poor qualities of the crude article, rose steadily, and in 1864 reached 70 cents per pound. As an instance of the rapid multiplication of the uses found for rubber goods, it may be mentioned that in 1853 Mr. Day cleaned 55,000 lbs. of rubber, and in 1859 500,000 lbs.

Many of the difficulties in the manufacture of rubber having been overcome, and the processes reduced to a systematic and scientific train of operations, the manufacturers naturally began to turn their attention to the adulteration of the raw material with a view to cheapen and improve it. In their efforts to do this combinations of various substances were made with rubber, vegetable and mineral oils being used to some extent though with only negative results. A compound made by combining these materials in their natural state with rubber was too adhesive to permit of proper working, and the various ingredients had to be worked separately.

Having met with such signal success in other branches of the rubber industry, Mr. Day attacked this problem with the same earnestness and determination that he had brought to bear on those already solved. He made a long series of experiments with the set object of overcoming the obstacles which had hitherto presented themselves to other workers, the goal in view being the production of a compound which could be combined with rubber. The final result of these investigations was the discovery, or rather the building-up, of Kerite, the material which forms the subject of this article.

In the production of Kerite Mr. Day had solved the problem of finding a substitute for rubber in the shape of a compound which could be worked with it by machinery. He prosecuted his experiments at Seymour with great assiduity, and having made a discovery he applied himself with untiring industry to perfecting the new material. During the three years from 1867 to 1869 he made between two and three thousand experiments in different combinations of materials, and tabulated no less than 350 formulæ for making crude Kerite. As may be imagined, a vast number of different substances had to be experimented with, including the whole range of vegetable and mineral oils, bituminous gums and resins, sulphur, acids, alkalies, earths and mineral oxides.

Mr. Day at once applied his newly-discovered Kerite to the insulation of electric wires, an industry then in its infancy in this country, and his productions in this line met with prompt acceptance among the telegraph companies, who were at that time almost the only users of insulated wire. He soon saw that he had embarked in an industry which offered a profitable field and one capable of wide development, promising a rapid natural growth with the increase of electrical applications in the industrial arts. Accordingly he gave himself up to studying the manufacture of insulated wire, and in order to profit by the experience acquired in the old world where this branch of the art had long ago reached a high pitch of excellence owing to the multiplication of submarine cables, the construction of which has always remained in England, he paid a visit to Europe in 1870 and spent nearly two years there, during which time he acquired much information regarding the state of the rubber and cable industries. In 1872 Mr. Day returned to Seymour, and with his increased knowledge of the peculiarities of insulated wires and cables, as well as of the needed improvements in his crude Kerite and its combination with rubber, he started in to organize his wire and cable factory on a systematic and scientific basis.

Since then the record of the Seymour factory has been one of uninterrupted prosperity, and Kerite wire is so well known all over this country that in many companies the word "Kerite" is printed on forms as a conventional name for insulated wire.

No doubt many users of Kerite will, after reading the brief foregoing sketch of its inventor, be interested in following this material through the various stages of its manufacture, as explained and illustrated herewith.

FIG. 2.—PORTION OF THE GRINDING AND CLEANING PLANT.

In the accompanying illustrations, Fig. 1 shows the department where the first operation in making Kerite is performed. In the large cauldrons are mixed the various materials of which the crude Kerite is composed. These materials are several in number, but how many, what they are and in what proportions they must be mixed in order to attain the desired result it is scarcely necessary or proper to specify here. Suffice it to say they are thoroughly incorporated for several hours at a high degree of heat.

When the mixture has reached the correct stage of this process, which is easily recognized by the men who keep a careful watch over each cauldron, it is run out into a fresh cauldron, in which it is subjected to a different degree of heat for a short time and then allowed to cool. By this operation a chemical combination of certain of the components of the mixture is effected and the manufacture of the crude Kerite is then complete. The compound is run out in slabs or thick sheets, rolled up and stowed away in dry store-rooms for some time before being mixed in with the pure rubber, as Kerite, like good wine, improves with age. In the next department, illustrated in Fig. 2, a large, well-lighted shop, the inquisitive visitor to the Kerite factory is shown the grinding and cleaning plant for treating the pure rubber and ridding it of impurities, and the rolls and without further acquaintance they are indissolubly united by means of an elaborate ceremony performed by the heavy steam-heated rolls which line the room. The rubber is made soft and plastic by being passed through the rolls a number of times and the crude Kerite is treated in the same manner; they are then brought together and the operation is repeated time and time again until the materials are so thoroughly incorporated together that they form a dark chocolate-colored homogeneous mass in which it is impossible to distinguish any sign of one ingredient preponderating over another or of one portion failing to become properly mixed in with the rest.

This part of the process completed, the full-fledged Kerite insulating compound is made, and it is then transferred to the wire-covering department to be applied to the

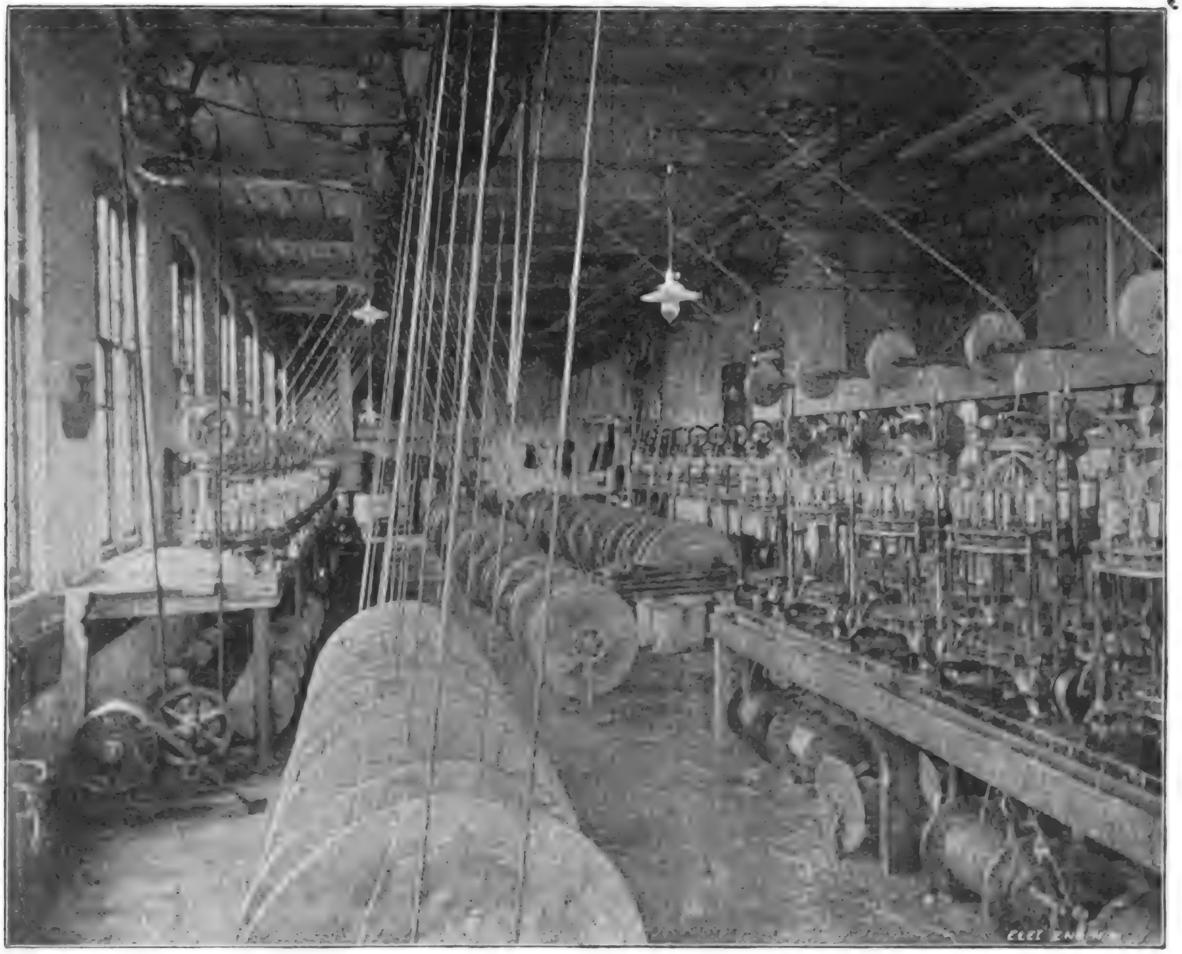


FIG. 5.—ONE END OF THE BRAIDING ROOM.

calenders for incorporating the crude Kerite with the rubber to make the final compound.

The grinding-machine for cleaning the rubber is of very ingenious construction. It consists of two heavy steel rollers studded over their entire surfaces with diamond-shaped projections. The rollers are so arranged that as they revolve the diamond-shaped studs of one fill up the spaces between those of the other. As can readily be imagined the rubber gets very thoroughly ground and purified in this machine, and there is no chance of any impurities escaping its very pressing attentions. After the rubber has been ground and cleansed in this manner it is hung up in the shape of long, thin, crinkled sheets, which look for all the world like so many alligator skins, in a dry loft, where it is left for many weeks to allow it to become thoroughly dry before being mixed with the compound.

At the appropriate time the rubber and the crude Kerite are introduced to each other in the calendering room and

wires. A view of this part of the process, showing three of the covering machines in operation, is given in Fig. 3.

The compound, in the shape of thick slabs or sheets, is brought to an operative stationed at the bench in the background, by whom it is cut into long strips and fed into a straining machine which forces it through a die-plate having a number of exceedingly small holes. This strainer arrests any particles of foreign matter that the compound may have picked up in course of transit from one shop to another, or from handling, and the compound emerges in what might almost be termed chemically pure condition. Bearing the appearance of a mass of uncanny, writhing worms it is now transferred to the covering machine, into which it is fed by the operative in charge. The covering machine is exceedingly ingenious and at the same time of simple construction, and it is a perfect marvel of compactness. The body of the machine stands at right angles to the line taken by the wire in passing through it and in the

space of a few inches the wire is provided with a well-fitting covering of insulating material.

The plant is arranged as follows:—The wire, which has been previously tinned by a special plant arranged for that purpose in another part of the factory, is wound on a light iron drum about four feet in diameter, which is mounted immediately behind the covering machine. This consists of a cylinder into which the strained compound is fed, and in which it is forced along by a screw until it reaches another and smaller cylinder attached at right angles to the main one. The wire enters this small chamber through a tiny hole and leaves it at the opposite end through a circular die, by means of which the amount of insulating compound to be applied is regulated. As it travels through the chamber the wire gathers its coating of compound, which is laid on with perfect evenness, securing exact centrality of the wire and smoothness of the insulation. On emerging from the die the wire travels along a short wooden trough and is coiled into the vulcanizing pan. This pan is of iron, about nine feet in diameter and six or eight inches deep; it is mounted on a small trolley in such a manner that the men who coil the wire down can, by a very slight effort, keep the pan revolving all the time, which, of course, greatly facilitates their work. As the wire is coiled down in the pan it is covered up with powdered soapstone and is then ready for vulcanizing. One of these large iron pans holds several miles of wire, and the whole operation of applying the compound to the wire is one of the most systematic and expeditious that we have inspected. It is all performed in an exceedingly small space as regards the flooring occupied by the plant and with a minimum expenditure of time and labor. In watching this process it is especially noticeable that one of the axioms of insulated wire manufacture is carefully borne in mind. Every hand that touches an insulated wire during its manufacture is a potential source of injury, and if the hands are many it is next to impossible to trace the defects and place the responsibility for them where it belongs. In the manufacture of Kerite wire, as we have pointed out above, the handling is reduced to the least possible amount. The

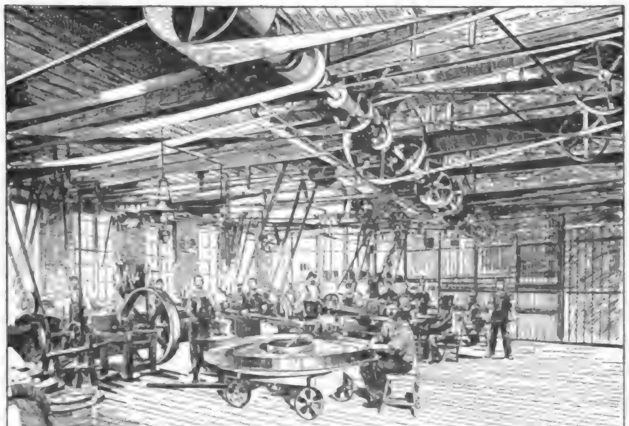


FIG. 3.—A GLIMPSE OF THE INSULATING DEPARTMENT.

wire passes from the covering machine along a trough filled with powder directly into the vulcanizing pan; the pan being revolved by hand no appreciable strain is placed upon the wire when in this delicate, new-born state, and the men in charge merely guide the wire so as to keep the turns slightly apart and each well coated with the soapstone. So deft do they become, after a little practice at this work, and so thoroughly do they seem to understand the susceptibility of the wire, that they barely handle it, guiding it to its place with the lightest touch possible. The machines through which the compound passes, such as the strainer and covering machine, are, of course, steam jacketted in order to keep the compound warm and plastic, consequently after leaving the die it is naturally still somewhat soft, and only by virtue of this careful treatment can large amounts of "faultless" wire be turned out.

When sufficient wire has been coiled into the pan this is wheeled away on its trolley to the vulcanizing room, a portion of which is shown in Fig. 4. Here a cover is fastened down over the pan and it is swung bodily into a large vulcanizing chamber of brickwork lined with iron and provided with a heavy iron cap which is bolted on by substan-

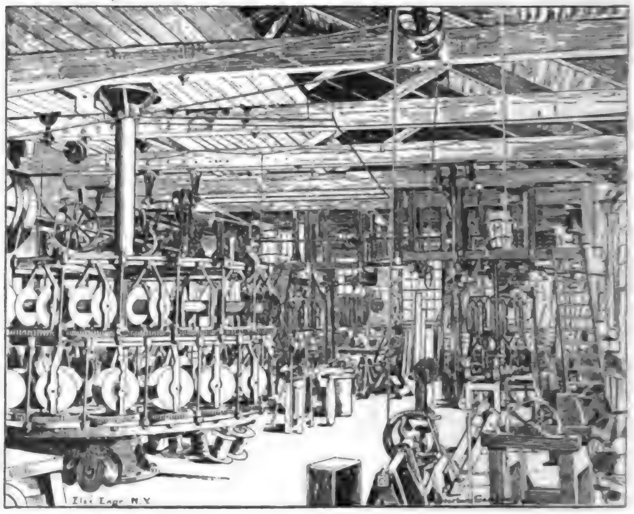


FIG. 7.—ANOTHER VIEW IN THE ARMORING AND CABLING DEPARTMENT.

tial screws and nuts. Live steam is circulated in the vulcanizing chamber for several hours, at the end of which time the manufacture of Kerite wire is complete. The pan is then taken out and the wire is wound off on reels, which are submerged in a large shallow tank placed just outside the testing room. The wire is all tested with a delicate reflecting galvanometer and a battery of about 200 volts before being made up into cables or sent out of the factory; and, as can readily be understood from the above description of the covering process, it is an exceedingly rare occurrence for a defective coil to be revealed.

A large proportion of the wire turned out receives additional protection in the shape of braiding and preservative compound, so that a visit to the braiding-room, a portion of which is illustrated in Fig. 5, is next in order. This department is on the second floor of the factory and contains a large number of the ingenious braiding machines, which are sufficiently well known to need but slight description. The light iron drums of wire are placed underneath the benches which support the braiding machines; the wire passes up through the machines where it is braided and impregnated with preservative compound, and then over a system of pulleys to a wooden spool, on reaching which it is complete and ready for shipment. The wire travels comparatively slowly, and as it is in the air for a considerable distance between the braiding-machine and the wooden spool, the outer covering of braid and compound is perfectly dry by the time the wire is wound up. The whole operation is entirely automatic; if a single thread breaks the braiding machine stops and the wire travels no further until the rupture is made good. This busy department with its large number of machines is constantly in full swing and many miles of wire are braided every day.

The factory at Seymour has built up an enviable reputation, now of many years standing, for the excellent work turned out in the line of submarine and aerial cables; in fact, until quite recently Kerite submarine cables stood practically alone in the market, and even now they enjoy a

conspicuous place in public favor by reason of their all-round excellence of manufacture. Submarine cable engineering on a large scale has been pretty well monopolized on the other side of the water; it is an industry extremely technical in its nature and largely dependent on the experienced skill and care of all hands employed in it. Although Mr. Day did not aim his ambitions at ocean cable work he realized that there were sufficient rivers, bays, and other stretches of water in and about this country to cause a demand for short submarine cables, and, always quick to seize an opportunity, he at a very early date laid out his factory to supply this demand. Consequently he and his workmen acquired ample experience in the construction of submarine cables long before most of the insulated wire factories in this country had sprung into existence, and so well is this fact recognized by other companies in the same business that it is no uncommon occurrence, when orders for submarine cables are obtained by some of them, for the wires to be sent to Seymour to be armored.

In Figs. 6 and 7 are views of the large shops containing the big "sun-and-planet" armoring machine, and several smaller cabling machines for laying up aerial cables and the cores for compound submarine cables. This is one of the most important departments in the Seymour factory, as cable of all classes, aerial and submarine, is constantly being manufactured, and Kerite cables are to be found overhead and under water in all parts of the country. Much of the machinery used here, as in the other departments, is peculiar to this factory and has been constantly altered and improved during the many years' experience of the treatment of insulated wires and cables that those in charge of the work can boast of.

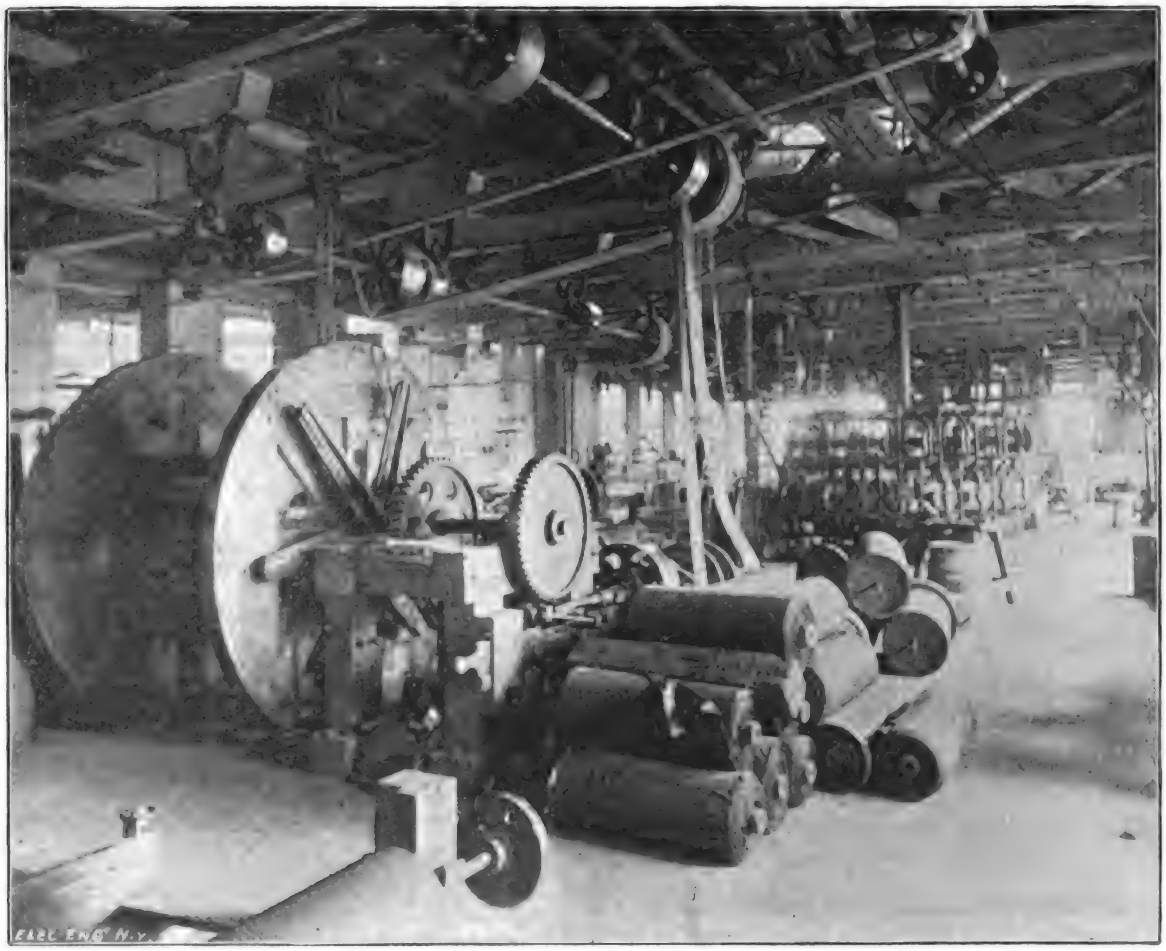


FIG. 6.—VIEW IN THE CABLING AND ARMORING DEPARTMENT.

Another important branch of the work done at Seymour is the manufacture of Kerite tape for making joints in insulated wires. This tape is a special production of which the proprietors of Kerite feel particularly proud, a feeling in which they are justified by the long record of good and useful service which the tape has achieved since its introduction. A great deal of experimenting has been done, in the years gone by, to make this very necessary adjunct to electrical construction the perfectly reliable material that it is, and special machinery has been designed for its manufacture. The tape is made with the same compound that is used for covering wires, the compound being employed for this purpose in its unvulcanized state. By means of a very heavy calendering machine of special design rolls of cloth of a particular texture and suitably prepared so as to be perfectly dry and free from any foreign matter are impregnated with the compound under the influence of steam heat and heavy pressure. So thoroughly is this part of the process carried out that it is difficult to tell whether the cloth is impregnated with Kerite or the Kerite impregnated with cloth; the result is practically a fine sheeting of unvulcanized Kerite strengthened by means of the textile fabric. The cloth is rolled up on a light drum and cut into the proper width for tape, which is then wound off on little wooden spools. This Kerite tape is a prime necessity for making waterproof joints in vulcanized insulated wire and it possesses the peculiar property of self vulcanizing by exposure to the sun and atmosphere. Joints made with this tape in the most exposed situations, have been known to last in perfect condition for many years. The manufacture of the tape goes on continually at Seymour and many thousands of rolls are sent out every year.

We have already shown how Mr. Day devoted his whole time to the study of rubber and how he was led to the discovery of Kerite, which thenceforth claimed his entire attention and caused him to acquire a knowledge of the technique of another industry—that of the manufacture of wire and cables. In this he was assisted by two very able lieutenants, Mr. A. G. De Wolfe and Mr. W. R. Brixey, the former of whom is now on the retired list, the latter in active command of the factory. Mr. De Wolfe was with Mr. Day when the manufacture of insulated wire was first begun at Seymour and to his mechanical ingenuity are due many of the appliances and machines used in the various processes of insulating and cabling. Mr. De Wolfe is thoroughly familiar with the entire work, root and branch, and has every detail at his fingers' ends. Since 1858 he has been engaged in studying the needs of an insulated wire factory, and almost since the same date he has been occupied in supplying them, as far as improvements in the permanent plant and processes are concerned. Much of the machinery now in use at Seymour was originally designed by him, and by him improvements have from time to time been made, both in his own inventions and in the machinery which has been adopted from outside.

Mr. De Wolfe is now well advanced in years and has retired from active work, but he pays almost daily visits to the factory, enjoying all the pleasure an inventor feels when watching the creations of his brain and fingers doing nimble service and turning out useful products. A chat with this veteran is a pleasant feature of a visit to Seymour, as he is surcharged with an inexhaustible fund of information on a variety of subjects, and a good listener can get a number of useful "pointers" from him in the course of a short talk.

Mr. W. R. Brixey has been the superintendent of the factory for upwards of ten years. Originally a nautical man, Mr. Brixey has brought all a sailor's ready resource and love of neatness and order to bear on the organization of his work at Seymour. Having originally a strong bent for mechanics, he very quickly mastered the processes in which mechanical work plays an important work; his sailor's training was a good preparation for the acquirement of general knowledge, and with a natural faculty for "catching on" to new ideas quickly he soon learned all that Mr. Day and Mr. De Wolfe could teach him, and in six months was as much at home in the factory as if he had been brought up there. That Mr. Brixey thoroughly understands the art of securing the best possible results with the least expenditure of space and labor is plainly apparent from a very cursory examination of the factory at Seymour. Those who can judge of the extent of the business done in Kerite wires and cables would naturally expect to see a very large factory and a great number of hands at work. As a matter of fact the works, although commodious, are by no means of startling size and the operatives employed are not so numerous as to crowd each other; which goes to show that scientific management, high-class machinery and intelligent organization are able to do a great deal in getting the maximum benefit out of the minimum of space and manual labor. Mr. Brixey thoroughly understands this and also appreciates the value of careful supervision of all branches of the work, down to the smallest detail. He is works-manager, engineer and electrician all in one, being a superintendent in the full sense of the word; and while he remains at Seymour there is no fear of any falling away from the standard of excellence so long maintained by the products of the Kerite factory.

In the foregoing description we have endeavored to give some idea of the manufacture of Kerite wires and cables and of the workers who have been, and are, prominently connected with this industry, one of the oldest established in American electrical circles. Some points have necessarily been omitted, but to do adequate justice to such an interesting theme would require more space than we can devote to any one subject. We have no doubt, however, that many of our readers who seldom have an opportunity of watching the evolution of insulated wires will have accompanied us in our ramble through the Kerite factory with a great deal of interest and profit.

Our thanks are due to Mrs. A. G. Day and to Mr. G. B. Prescott, Jr., general agent for Kerite, for the facilities placed at our disposal in the preparation of this article.

ON THE CONDUCTIVITY OF SOLID AND FUSED SALTS.[1]

BY L. GRATZ.

The data hitherto published on the conductivity of solid and fused salts differ for each salt when determined by different observers. The author was extremely careful to keep the salts at constant and accurately measured temperatures. The salts were fused in a small porcelain crucible 2.8 cm. high and 2.2 cm. diam., heated equally in a sand bath. In the salt were placed stout square, platinum electrodes of 2.25 square cm. surface. The electrodes were freshly platinized before each test. To prevent cooling of the electrodes by conduction of heat through the connecting wires, about 20 cm. of the latter were also put in the same bath. The resistance of the salt was measured by the alternate current and an electro dynamometer. The capacity of the crucible was determined by a solution of magnesium sulphate. All readings were taken with decreasing temperatures in order to obtain greater constancy.

In spite of the fact that many of the salts on solidifying showed porosity, a general agreement was found between the results for the same salt in the solid and fused state. With some salts, just at the point of fusion, a remarkable change occurs in the volume or in their conductivity; with others, the conductivity alters rapidly at a temperature below the fusing point; and with a third group, a steady change only is observed. It appears, therefore, that the only difference between salts in the solid and fused state is due to an action of an electrolytic nature, as Warburg has already proved in the case of glass and crystal. Clausius' theory, therefore, that in solid bodies the molecules oscillate about a position of equilibrium, but cannot separate from their own group, cannot be accepted. The idea of a sharply-defined difference between solids and liquids must also be abandoned as it seems to have no existence in nature. Liquid molecules exist in every solid, even when the latter show no approach to the softened state.

1. From Wiedemann's *Annalen*, Vol. 40, No. 5.

THE BROWN ELECTRIC LEAK DETECTOR.

It is not generally known, though it is nevertheless a fact, that property aggregating many thousands of dollars is destroyed or damaged every year in this city alone by overflows or leaks from the hydrants, bath or toilet rooms, as well in business apartments as in private houses. Unlike damage in the case of fire, there is no insurance for this class of loss, which is thus irretrievable. A safeguard against such loss is therefore eminently timely, and has been worked out in a very simple manner by Mr. Andrew H. Brown, of this city.

The apparatus, which is now being exhibited at the

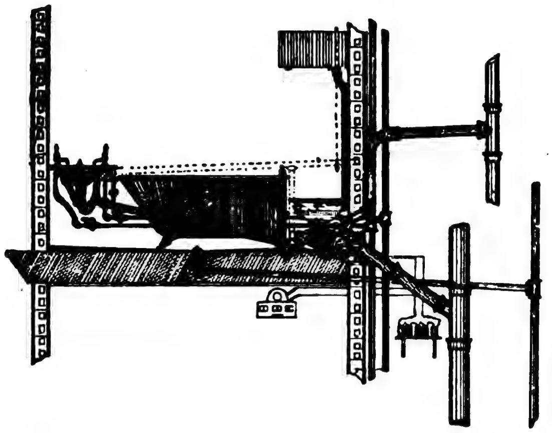


Fig. 1.—The Brown Electric Detector of Water Leaks.

American Institute Fair, where it attracts much attention, consists of a simple circuit closer acted upon by the presence of water and connected with an annunciator which locates the leak at once.

The accompanying engraving, Fig. 1, shows the application of the leak detector to a bath or toilet room. The circuit closer is shown full size in Fig. 2. Its operation is exceedingly simple. When any of the pipes, couplings, joints or valve glands leak, or an overflow occurs on any floor, the water drips into the pan or safe, and flows into the bucket valve of the detector. When the quantity

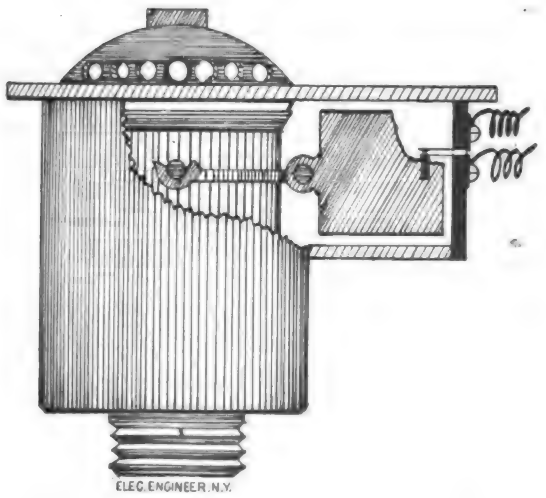


Fig. 2.—The Brown Electric Detector of Water Leaks.

equals a tablespoonful the valve falls by the weight of the water and brings the free end of the lever against the contact points in the annunciator circuit, closing the circuit to the annunciator; this rings an alarm, and at the same time indicates in which room, apartment or floor the leak has occurred, so that preparations can be made, or measures taken to stop the leak.

With this arrangement the usual "safe waste" pipe may be dispensed with, so that a considerable reduction in the expense for the plumbing equipment of a house may be effected.

IMPROVEMENTS IN ELECTRIC RAILWAY CAR DETAILS.

BY T. C. FRENYEAR.

If allowed a little space I should like to call attention to the bearing which Dr. W. L. Allen's admirable paper, read before the American Street Railway Association and published in The Electrical Engineer of Oct. 22, has toward the appliances of The Short Electric Railway Co., with which he seems not to be familiar; especially as some of the difficulties he mentions have been recognized and overcome in the Short system.

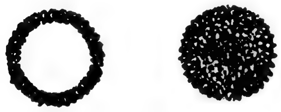
Dr. Allen says: "We want gear of some material that will be reasonably durable, and at the same time noiseless," and "To overcome the noise, it is necessary either to have the gear covered and running in oil, or to have the gear of wood or the pinion of rawhide." There is nothing to wear like steel, and it is therefore preferable to use steel gears and pinions, if the noise can be stopped. Rawhide pinions wear out very quickly, wooden gear teeth have yet to prove whether they will long stand the very hard usage to which street car motor gearing is subjected. But a *wooden web* between the steel hub and steel rim of the gear wheels has proved to be a sure preventive of noise, and has made it possible to retain the longest lived gearing known. In the Short system the teeth are also made very large so that it is impossible to strip the gear, and a form of construction is used which makes it possible to take up the wear of the gearing, thus further lengthening its life.

The chafing of the armature wires, which Dr. Allen speaks of as being a fruitful cause of burn-outs, is entirely prevented by the use of the "ring" armature, as in it each bobbin is separate and there is no bunching of wires.

Burning out from "grounds" is also prevented by insulating the motor from the truck. The practical value of these devices is evidenced by the freedom from repairs wherever they have been adopted.

COPPER OXIDE FOR STORAGE BATTERIES.

Our readers may already be aware that for some time past numerous important experiments have been carried on by Messrs. Justus B. Entz and Montgomery Waddell in



The Entz and Phillips Storage Battery.

adapting copper oxide for use in the storage battery. For this purpose they employ a tube of woven copper wire which is filled with copper oxide, as shown in the accompanying illustrations. In the employment of pure copper oxide, however, trouble has arisen from the lack of coherency of the material.

To avoid this, therefore, Mr. Entz, in connection with Mr. Wm. A. Phillips, has recently modified the composition by combining with the oxide of copper a small portion of sulphur, and then heating the mixture. The sulphur is thoroughly mixed with the oxide and then applied to the woven copper wire. The whole is then heated to burn off the sulphur, but in so doing the oxygen of the oxide of copper is absorbed to form the SO_2, leaving the oxide in a reduced or partially reduced state on the support. The heating then being continued, the exposed portions of the particles of the mass are reoxidized, while the unexposed portions at the juncture being protected from the air remain metallic and serve to hold the mass together. The sulphur, when used in this manner, therefore acts as a binding, toughening, or hardening agent without being actually present in the mass after the treatment.

The oxide of copper thus formed has about the same consistency and qualities as the resultant mass of the first process above mentioned.

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Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.
Western Manager, W. F. COLLINS, Temple Court, 225 Dearborn Street, Chicago, Ill

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VOL. X. NEW YORK, NOVEMBER 12, 1890. No. 132

If an invention at once takes a place in the arts as a practical thing, or if it so clearly embodies a great step forward that the inventor or others are incited to develop it to a practical or pecuniarily profitable application, it constitutes a progress, and the purpose of the law is satisfied.—J. J. Storrow.

THE ECONOMY OF THE ELECTRO-DEPOSITION OF COPPER.

THE high economy called for in the many devices requiring the employment of copper, whether in the form of wire, of rods or of bars, has, during the last decade, served to bring the electrolytic refining of copper into considerable prominence. As a result, a number of works have gone into operation both in this country and abroad in which many tons of refined copper are deposited daily from copper matte, the residue remaining in the tanks being generally re-smelted to obtain the gold and silver contained in it. The continuance of this method of obtaining refined copper, as well as the presence of unmistakable signs that it is rapidly gaining in favor, would appear to be sufficient proof of its economy from a financial standpoint, and hence we are not surprised to note the formation abroad of various companies to exploit the new Elmore process of copper deposition, in which a dense and tough deposit is obtained by the action of a burnisher, maintained in continuous contact on the freshly deposited surface. We are, of course, not concerned in the slightest degree with the financial policy adopted by the exploiting company, but note that in a leading editorial, the London *Electrical Review* attacks with customary vigor and incisiveness a report made by Dr. John Hopkinson to the Elmore directors, and attempts, by certain calculations, to show that the actual cost of production of electrolytically refined copper is much understated.

While we do not doubt that Dr. Hopkinson is well qualified to sustain any statements made by him, it appears to us to be a duty to point out some errors into which our contemporary has fallen, and which, if allowed to go uncorrected, might be cited against the establishment of future works of this character.

Before we proceed, however, it might be well to point out the fact that our contemporary's errors are largely due to its close confinement to the text-books on the subject. However valuable these may be, and are, in other departments of applied electricity, their data on the electro-deposition of copper from copper matte is exceedingly meagre and indefinite, due no doubt to the secrecy with which these processes are still surrounded by their operators. Enough, however, is known in America, at least, to set at rights the obvious miscalculations referred to.

Unmindful of the fact that operations of this nature are carried on continuously night and day, our contemporary takes the figure of Rayleigh and Roscoe, that 1 ampere deposits .0050478 grain of copper in one second, and figures out that to deposit, say, 20 tons in *one week of* 60 *working hours,* would require a current of

$$\frac{20 \times 7000 \times 2240}{.0050478 \times 60 \times 60 \times 60} = 287,620 \text{ amperes.}$$

It goes without saying that by working the plant, as is done in regular practice in America, 24 hours per day instead of 10 hours, as assumed by our contemporary, a proportional reduction to nearly $\frac{2}{5}$ of the above figure will give the same deposit of copper, with a corresponding reduction in the number of generators, vats, etc., required.

Then taking John T. Sprague's figure of 18 amperes per square foot of surface, our contemporary figures the size of plates required to be

$$\frac{287,620}{18} = 15,976 \text{ sq. ft.} = 127 \text{ ft.} \times 127 \text{ ft.}$$

The fact has evidently escaped our contemporary that *both sides* of the depositing plates are employed in practice, so that the 15,976 sq. ft. of plates would be divided by 2 with a corresponding saving.

Our contemporary then goes on to calculate, or rather speculate on, the number and size of the tanks required to deposit 20 tons of copper, on the assumption, first, that working tanks in series confers no benefits whatever, and, secondly, that each vat requires 1 volt to accomplish deposition.

As regards the benefits of working in series, it may be remarked that, theoretically, any amount of metal can be deposited with a given power, disregarding the counter E. M. F. of the depositing vats, which is usually small in a properly arranged plant of this nature. But the limiting quantities are evidently, on the one hand, the cost of power, and on the other, the cost of vats, copper under treatment, buildings, etc. With relatively high cost of power the number of vats may be advantageously increased, and it may be stated generally that to obtain an increased deposition with a given power, the number of vats must be increased in the square of the desired ratio of increase. The question here is, therefore, merely one of determining the limiting point of relative economy.

But the assumption that it requires 1 volt per vat to obtain deposition involves a most serious error, when we con-

sider that the results of actual practice demonstrate that .5 volt, and less, is ample to afford deposition. Based on the assumption of 1 volt, our contemporary figures that it requires .5 h. p. hour to deposit 1 pound of copper. Still assuming the necessity of employing one depositing tank, it remarks, that "if the working E. M. F. were less than 1 volt, then the cost would be proportionally less, but this, on the other hand, would involve a great increase in the size of the depositing tanks to enable the required current to pass." The fallacy of this argument, in the light of what has just been said, is obvious.

But perhaps the best proof of the errors into which our contemporary has fallen is to be found in its own citations of the results accomplished at one or two refining works of this nature. Thus it mentions the case of the North German Works, in which 1 pound of pure copper is obtained with an actual consumption of .4 h. p. hour against the .5 h. p. hour, theoretical. But the figure cited is by no means the best which can be obtained, and we know, "of our own knowledge," of actual cases where 1 pound of refined copper is being deposited with a consumption of .33 h. p. hour, delivered from the engine pulley.

As the industry of copper refining by electrolysis, already well established in this country, is likely to be considerably extended in the near future, it has not seemed out of place to controvert statements, which, in view of our contemporary's well recognized standing as an authority, are apt to mislead, with serious results.

INCREASING THE LIFE OF CARBONS.

ALTHOUGH comparatively little has found its way into print on the manufacture of carbons for arc light purposes, it may be stated as a fact that this vital part of the lamp has been the subject of as much study and research as any other portion of arc lighting taken as a system. It was recognized from the very first that the expense due to the consumption of carbons, including the trimming of lamps, was a large item in the cost of maintenance of arc light stations, and that the prolongation of the life of a carbon was a matter of considerable importance. The early attempts to increase the brilliancy of the arc by an admixture of various mineral earths, was therefore soon abandoned, being found detrimental to the life of the carbon. It was soon recognized—and has since been verified by actual practice—that independent of the process, the purest and most homogeneous carbon has the longest life. Still, the ever-restless mind of the inventor has continued to seek improvement, and as such the device due to Mr. W. B. Hazeltine Jr., referred to on another page, is worthy of the most serious consideration by all users of arc light lamps. The well-substantiated claims made by the inventor leave no doubt in our minds that a distinct advance has been made in the art, and one which cannot fail to have a corresponding influence for good upon its progress, affecting as it does, not only the producer, but the consumer as well. A short time ago we illustrated and described the Saunderson arc lamp "wick," in which a cavity in the carbon is provided with a small reservoir of oil. It would be interesting to know what has become of that device for increasing brilliancy. In the meantime, the Hazeltine device may be welcomed as a very practical means of increasing the longevity of the carbon, and of diminishing the cost of attendance.

ELECTRO-OPTICAL MEASURING INSTRUMENTS.

THE frequent corrections which are necessary to obtain standard readings from electric measuring instruments embodying permanent magnets or dependent upon the action of the earth's magnetism, make it an object of importance to seek some substitute which, having equal accuracy, shall at the same time be more constant in its indications. Such a method seems to be at hand in utilizing the phenomenon of the rotation of a beam of polarized light by the current. The application of this phenomenon for the purpose described, though hinted at, seems up to the present to have received no serious consideration, and hence the contribution of Mr. A. E. Kennelly on this subject, to our columns, will serve to draw attention to a subject which is well worthy of consideration. In the application of the phenomenon to the construction of optical ammeters and voltmeters, Mr. Kennelly shows the various factors which enter, and the limitations to which such an instrument is subject. While Mr. Kennelly does not claim for this type of instrument a place among practical every-day apparatus, the results obtained by him seem certainly to justify the claim that it possesses distinct advantages for laboratory use as a standard, not only on account of constancy, but because of its ease of manipulation. We hope that some of our instrument manufacturers may take up this subject in a practical way.

Defects in Ship Wiring.

ANOTHER instance of poor wiring, or faulty insulation, on shipboard, is reported in the daily papers this week, and the fact that the fire was only a little one, promptly extinguished, does not render the case less grave. Such "accidents" ought not to happen. As both the steamers recently concerned were wired in England, we cannot speak positively as to the wire used or its quality, but it is evident that either the wire or the construction work was bad. Perhaps neither was as good as it should be. In view of the special conditions of exposure at sea, these wires should be of the best quality, and they should certainly be run through the waterproof and fireproof "conduits" now a standard commodity for purposes of safety. In matters of this kind the traveling public has the right to expect that resort will be made to every measure and means of protection known in electric lighting. And the rules to be observed are not in any sense exacting.

Insulated Wires and Cables.

ONE of the most interesting articles in this issue is that which describes and illustrates many of the processes devised and employed by the late Mr. A. G. Day, in the manufacture of insulated wires and cables. We are glad thus to pay a tribute to the memory of one who did so much in this country to develop and perfect the difficult art of insulation, upon which to-day in fact the whole electrical industry depends. The pithy paper read by Mr. Fred Degenhardt, before the Chicago Electric Club, shows how vital to efficiency and success good insulation is.

ON THE BEST DIMENSIONS FOR STANDARD OPTICAL AMMETERS AND VOLTMETERS.—I.

BY A. E. KENNELLY.

ATTENTION has recently been called to the application of the optical galvanometer to the measurement of current strengths, utilizing the electro-optical laws of Faraday, Becquerel, Wiedemann, and Verdet.

The advantage possessed by the method is its almost complete freedom from local magnetic disturbances to which galvanometers as a class are subject, and also its capability of rendering current strengths in absolute measure from purely geometrical data, having given a good rotatory polarization apparatus of the saccharimeter type, and a pure chemical medium for the light to traverse, with a reliable electro-optic constant. Such an instrument is unfitted for practical indicators of current or E. M. F. in engineering practice, and can at present be only used advantageously for standard measurements. In these, however, it possesses a very fair degree of accuracy, and a convenience in manipulation second only to that afforded in the use of the gravitational measurers of Sir Wm. Thomson. It is proposed to discuss the conditions that lead to the best construction of the instrument as these apparently have not yet been published.

The liquid medium generally adopted is bisulphide of carbon, which can be obtained in the requisite degree of purity without difficulty, which possesses a high, though by no means the highest, specific rotary power among liquids, and which has probably received the most careful determination of that power under the title of the "Verdet Constant."

It will be advisable to examine mathematically the best conditions for securing the greatest amplitude of rotation for any given current, and the limitations to which that amplitude is subject. The practical formulas for determining the best winding for the various classes of instruments will then directly follow.

Let c be the current flowing through the helix; (amperes).
" e " E. M. F. acting on the helix, or the p. d. between its terminals, assumed steady; (volts).
" r " resistance of the helix; (ohms).
" l " length of the helix; (centimetres).
" a " internal radius of the helix; (centimetres).
" b " external radius of the helix; (centimetres).
" m " mass of the helix; (grammes).
" n " number of turns in the helix per centimetre of its length.
" N " total number of turns in the helix or $l\,n$.
" σ " specific gravity of the conductor in the helix.
" d " diameter of the conductor; (centimetres).
" D " diameter of the covered wire.
" v " magnetic potential difference between the ends of the helix axis of the liquid column, in absolute measure.
" φ " "Verdet Constant," or the rotation in the medium of a plane polarized series of luminous vibrations with given frequency, for unit electro-magnetic p. d., expressed in minutes of arc.
" θ " observed angle of rotation; (minutes).
" ρ " resistivity of the conductor at working temperature; (ohms per cubic centimetre).
" h " heat developed by the current in the helix per sq. cm. of its external surface per second; (watts).

Then the fundamental electro-optic law is :—

$$\theta = v\,\varphi. \qquad (1)$$

To a first approximation, very nearly accurate for a long thin helix,

$$v = \frac{4\,\pi}{10}\,c\,N = \frac{4\,\pi\,e\,n\,l}{10\,r}. \qquad (2)$$

The correction for the reduction in magneto-motive force due to the influence of the free solenoidal poles is a simple one. It can be deferred for the moment if it is remarked that in virtue of this correction, the actual length l of the helix becomes a virtual length L where $L = l - \lambda$ and consequently equation (1) becomes strictly

$$\theta = \frac{4\,\pi\,n\,e\,\varphi\,L}{10\,r}. \qquad (3)$$

In what follows, the uncorrected length l only will be considered, since the correction is usually small, and can always be separately introduced.

Developing N and r of (2) in terms of the dimensions of the solenoid,

$$N = \frac{l\,(b-a)}{D^2}; \qquad (4)$$

$$r = \frac{4\,\rho\,l\,(b^2-a^2)}{D^2\,d^2}. \qquad (5)$$

This is on the assumption, realizable with care in practice, that the wire is uniformly and accurately wound on the solenoid without paper or other insulating material between the layers or turns. This assumption is involved in all that follows. Substituting in (1) and (2),

$$\theta = \frac{\pi\,e\,\varphi\,d^2}{10\,\rho\,(b+a)}. \qquad (6)$$

This shows that the amplitude of rotation obtainable from a helix for a given potential difference between its terminals, that is, when used as a voltmeter, does not in the first instance depend upon the length of the helix, but varies directly as the sectional area of the wire, and inversely as the mean radius of the winding. This means, that for a given winding space, the amplitude would increase indefinitely with the sectional area of the wire used in winding the instrument.

Practically, however, the limit is reached owing to the strength of the current in the helix, and the heat that current would generate during the measurement. This heat not only alters r, and affects to a certain extent the specific rotary power φ, but also interferes with the working of the apparatus by setting up differences of density in the liquid column, thus refracting, scattering and obscuring the beam of light. A jacket of insulating and circulating water if inserted between the tube and helix, would certainly act as a shield, but would by no means add to the convenience of the instrument, while it would tend to reduce its effectiveness in another direction by increasing the radius of the helix. In any case the variation in r due to any considerable rise of temperature would interfere greatly with the use of the apparatus for standard measurements. It therefore becomes necessary to so limit d that the heat generated may escape from the surface of the helix without materially raising its temperature or that h may not exceed a certain limiting value.

This value is strictly speaking a function of a and b; but for practical purposes, we may fairly consider the limit to be $h = 0.02$ watt per sq. cm. for intermittent and measuring currents, and $h = 0.01$ for a helix that has to remain in circuit and sustain a permanent current.

Expressing d in terms of h and the general dimensions,

$$d^2\,D^2 = \frac{8\,h\,b\,\pi\,l^2\,\rho\,(b^2-a^2)}{e^2}; \qquad (7)$$

and

$$b = a\sqrt{1 + \frac{4\,m}{\pi\,q}\left(\frac{D}{d}\right)^2} \qquad (8)$$

where $q = \pi\,a^2\,\sigma\,l$, or the mass of the space within the helix if converted into copper.

Hence

$$d^2 = \frac{\sqrt{l}}{e}\sqrt{\frac{32\,h\,\rho\,m\,b}{\pi\,\sigma}}; \qquad (9)$$

and $$\theta = \frac{4\pi\varphi}{10}\sqrt{\frac{lm}{\sigma}} \times \sqrt{\frac{2h}{\pi\rho\sigma}} \times \frac{b}{a+b} \qquad (10)$$

The last equation shows that when the current in the helix reaches the heat limit, the rotation obtainable is independent of the E. M. F., varies approximately as the square root of the mass of copper in the winding, and also as the square root of the dimensional ratio $\frac{l}{a}$. In other words, the same amplitude should be obtainable from all well designed instruments whether ammeters or voltmeters, and it is almost useless with a given weight of wire to increase the length of helix, notwithstanding the greater surface obtained, if the internal diameter be increased in the same proportion.

Taking $\sigma = 8.95$, $\rho = 1.8 \times 10^{-4}$ as values for copper:

$$\theta = 250\,\varphi\sqrt{\frac{l\,m\,h}{a}} \times \frac{b}{a+b}. \qquad (11)$$

For the D line of the sodium flame φ is given by Lord Rayleigh and Koepsel at 18° C., as 4.20×10^{-2}, so that

$$\theta = 1050.\sqrt{\frac{l\,m\,h}{a}} \times \frac{b}{a+b}. \qquad (12)$$

For intermittent currents and $h = 0.02$,

$$\theta = 1.485\sqrt{\frac{lm}{a}} \times \frac{b}{a+b}. \qquad (13)$$

For permanent currents, and $h = 0.01$,

$$\theta = 1.050\sqrt{\frac{lm}{a}} \times \frac{b}{a+b}. \qquad (14)$$

It is difficult to make l more than one metre, if only from the absorption of light in so long a column; it is also difficult to make the internal diameter of the helix less than 1 cm.; hence the practical limit of $\sqrt{\frac{l}{a}}$ may be estimated at 10. Again, a fair maximum for m would be 10,000 grammes, or 22 pounds of copper, and with the superior limit of the fraction $\frac{b}{a+b}$, namely, unity, we have for intermittent currents $\theta_{max} = 1485'$, or 24° 45′,
and for permanent currents $\theta_{max} = 1050'$, or 17° 30′.

These are then the approximate maximum amplitudes that can be practically obtained with any instrument of the class, although theoretically, there is no definite limit, as shown by equation (12).

It might be possible to double the amplitude of rotation by arranging a mirror at one end of the tube and causing the light to traverse the length of the liquid column twice in succession, but this is not only inconvenient, but probably needs an increase of illumination and of internal radius.

It is also to be regretted that no simple and definite standard of illumination can yet be adopted with a higher frequency than the sodium flame. Thus a monochromatic flame radiating violet light of the wave length G would more than double the amplitude of rotation. The effect might also be greatly increased by surrounding the tube with a bundle of annealed iron wires, but troubles would follow from residual magnetism, while the instrument would cease to give results directly in absolute measure from the indeterminate rate of change in the permeability of the iron.

Assuming the above then to be the practical limits of amplitude with instruments operating at their maximum capacity, the degree of accuracy obtainable depends only upon the degree of precision with which the amplitude can be measured. With a good polarimeter, and particularly with a repeating circle to eliminate errors of eccentricity, the limit of precision on steady currents should certainly not exceed 2′ of arc, and in fact when repeated measurements can be made, a mean rotation can always be found whose probable error is less than 1′; so that the degree of precision at full capacity attainable is certainly 1 part in 750, and probably 1 part in 1,500 with care and under the most favorable circumstances.

The best windings for such instruments may next be considered, and first for voltmeters.

Voltmeters.—Suppose the length of the helix given, the internal radius a, and the total mass of wire m to be wound, the maximum voltage to be measured being also given. It is to be remarked that the degree of precision in the observations with any instrument diminish as the current measured descends below the maximum current, so that they work best at full load.

The diameter of the wire to be used can be found from equation (9). In solving it a trial value can be given by estimation to the fraction $\left(\frac{D}{d}\right)^2$, and if this value should be found inaccurate by the result, the formula should be used again with the adjusted value. As an example, let it be required to determine the best winding for a voltmeter to operate at a maximum limit of 130 volts, the length of the helix being 62 cms. between flanges, and its radius 1.1 cm., allowing 10 pounds of wire in the helix, and a heat limit of 0.02 (intermittent currents).

Assuming $\left(\frac{D}{d}\right)^2 = 1.2$, formula (8) gives

$$b = 1.1\sqrt{1 + \frac{4 \times 10 \times 453.6 \times 1.2}{3.142 \times 3.142 \times 62 \times 1.21 \times 8.95}} = 2.277$$

Then by (9) $d^2 = \frac{\sqrt{62}}{130} \times$

$$\sqrt{\frac{32 \times 0.02 \times 1.8 \times 10^{-4} \times 4536 \times 2.277}{3.142 \times 8.95}} = 12.46 \times 10^{-4};$$

or, $\qquad d = 3.53 \times 10^{-2} = 0.0139''$.

When covered, this wire would have, say, a diameter of $0.017''$, so that $\left(\frac{D}{d}\right)^2$ would be 1.474. Repeating the reckoning with this value in place of 1.2, b becomes 2.468, and $d = 0.0142''$, in this case practically the same result.

The amplitude to be expected from the instrument at 130 volts would be, by (13),

$$= 1.485\sqrt{\frac{62 \times 4536}{1.1}} \times \frac{2.468}{2.468 + 1.1} = 519', \text{ or } 8° 39'$$

±, subject to correction for polar influence.

ELECTRICAL FOG SIGNAL.

Experiments with the Andrews electrical fog signa have recently taken place at Bowes Park, on the Great Northern Railway, in the presen e of a large number of railway engineers and directors. In this system an insulated rail is laid down parallel with the ordinary rails; and the current is conveyed to the engine by means of a metallic brush affixed to the footboard. There is an illuminated dial fixed on the weather-board of the engine, with a miniature signal and a gong to direct the attention of the driver to the sign given on the engine. In the signal-box are other miniature signals showing the signalman that the driver has received correctly the signal. The signal may be brought into action by the signalman immediately upon a fog coming on, simply by moving a switch.

UNDERGROUND ELECTRICAL WORK.[1]

BY FRED DEGENHARDT.

To Charles Augustin Coulomb no doubt belonged the honor of discovery of that most essential necessity of modern electricity, insulation. He it was, during the latter part of the last century, who developed the fact that the momentary dissipation of electricity was proportional to the degree of electrification at the time, and that when the charge was moderate, its dissipation was not altered in bodies of different kinds or shapes.

The temperature and pressure of the atmosphere did not produce any sensible change, but he concluded that the dissipation was nearly proportional to the cube of the quantity of moisture in the air.

In examining the dissipation which takes place along imperfectly insulating substances, he found that a thread of gum-lac was the most perfect of all insulators, as it insulated ten times as well as a dry silk thread, and that a silk thread covered with fine sealing-wax insulated as powerfully as gum-lac, when it had four times its length. He found that the dissipation of electricity along insulators was chiefly owing to adhering moisture, but in some measure also to a slight conducting power.

History, as far as the writer knows, is silent as to the first attempts at insulating wires commercially, for electrical purposes,

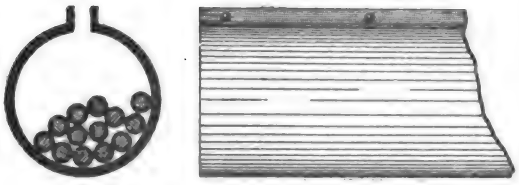


FIG. 1.

but as these remarks apply entirely to underground construction, we will refer only to the earlier efforts in that line, accepting at once the conclusion that wires had perforce been insulated. In 1829 Prof. Henry used insulated wire for experimental work.

It was during the year 1852 that Prof. Morse first conceived the idea of underground transmission of electricity, and among his earliest plans we have a suggestion of the conduits of to-day, and as these drawings are of historical importance, I have produced two views, as shown in Fig. 1, which will clearly illustrate the general similarity of ideas, covering a lapse of fifty-eight years.

Prof. Morse adopted the underground plan without experi-

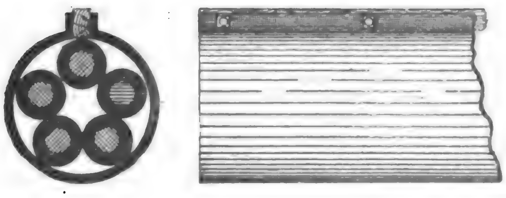


FIG. 2.

ment, not knowing the disastrous failures that had followed like attempts in England, and, strange as may seem, the very work in this line in this country, to-day carries with it the ear-marks of fifty years ago, and Morse's first cable was a bunch of five wires, lead encased. Prof. Morse's first cable was laid from Baltimore to the Relay House, seven miles distant, and the failure of this cable all but sealed the fate of underground electrical work; and while referring to these earlier experiments, I cannot refrain from a mention of the first attempts at overhead construction, simply that by comparison, we may show that at the present day, underground as well as overhead work has been perfected only after much cost and study. The first overhead insulation adopted on the line built by Prof. Morse, shows how rudimental were the conceptions of men at that period. The insulation consisted simply of two plates of glass, between which the wire, after wrapping well with cloth, saturated with gum shellac, was placed and over which a wooden cover to protect from rain and press the glass upon the wire, and keep it in place, was nailed. Fig. 3 will illustrate. (This was before the door-knob era.)

It is not necessary to further cite the history of experimental underground electrical conduction or construction. Enough that the problems involved came thick and fast, and the modern applications of electricity seemed for a time to have stamped the success of the underground branch of the business as an impossibility, but as each day proved the utility of the new agent, the fact also became apparent that we would soon be walled in by a network of wires, and at this period popular clamor arose, and Necessity once more became a fond mother, and her child, Invention, brought forth in turn a multitude of offspring, among which were some that had merit, and others which had none.

It is safe to say that underground work slumbered for a period of twenty years from the date of Prof. Morse's first experiments. When, in the city of Chicago, an objectionable pole line had been placed through a prominent residence portion of the city, the citizens of that particular section banded themselves together and selected a committee who waited upon Prof. Barrett, of the

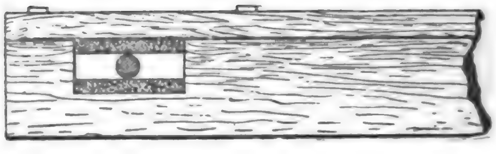


FIG. 3.

City Telegraph Department, of the City of Chicago, and stated their grievances.

The Professor told them that the line might be placed underground but that the city did not furnish the means for so placing it. After momentary deliberation, the gentlemen composing the committee volunteered to defray the expenses, and the poles were removed, and thus the first underground work was started in the city of Chicago. Eight hundred and forty feet of 2-inch wrought iron pipe was laid about three feet below the surface, the exterior of the pipe being first treated with a liberal amount of tar and linseed oil. In this pipe two insulated wires were placed. These wires are in service to-day, and are giving as good service as the day they were placed underground.

From this date on the underground question was agitated in the city of Chicago, and in the year 1883, the Common Council passed an ordinance requiring all electric conductors to be placed underground. In accordance with this ordinance, the various companies doing business in the city, after exhausting all means to evade it, adopted various systems for placing their wires under-

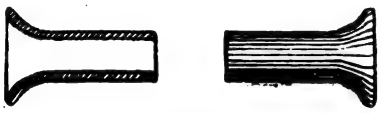


FIG. 4.

ground, and to-day the wires so placed underground embrace all branches of the service, viz., telegraph, telephone, police, fire-alarm, electric lighting and power. In 1883 a franchise was granted to the Sectional Electric Underground Co. to build underground conduits for commercial purposes. This company built about seven miles of conduit in the business district of the city, and rented space in the same, for $1,000 per mile per duct, per year, the city being allowed the use of one duct, free of charge.

The cables laid underground in the city of Chicago are placed in conduits of various kinds, viz., iron pipe laid in the earth without other protection; iron pipe laid in concrete; iron pipe, cement lined, laid in concrete and multitubular blocks of bituminous concrete about four feet long. Man-holes in many cases, are

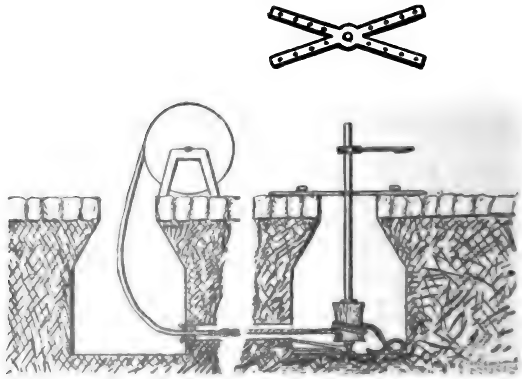


FIG. 5.

built circular in form, and in other cases, rectangular shaped, the latter averaging 46 inches in length by 40 inches in width, and are from four and one-half to nine feet deep, with double iron covers, one of which is set below the grade and made water-tight by packing, the other set on a level with the street.

The iron pipe used for conduit is thoroughly reamed at the

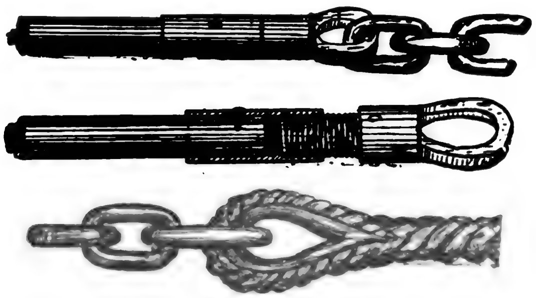
1. A paper read before the Chicago Electric Club, Nov. 3, 1890.

ends, thus removing the burr. Conduit is laid with a pitch or difference of grade from six inches to one foot, so as to draw into the man-holes, thus disposing of all drip from condensed moisture.

The usual specifications for underground conductors, for the purposes of arc lighting, may, perhaps, not be out of place, and I give them herewith: The insulation resistance should not be less than 500 megohms per mile, and the insulation should not materially deteriorate for the space of two years after being in service on an electric light circuit having a voltage of from 2,500 to 3,000 volts, and a current of from 9 to 12 amperes, or a voltage of from 900 to 1,200 volts, and a current of from 18 to 20 amperes.

The early method of preparing the trench for underground work, was to plough a furrow and place the conduit and the insulated wires in the trench thus made. To-day the tools and accessories are quite a feature of underground work, for after the conduits have been made and the ducts placed in most perfect alignment, so that no obstruction may be offered to the introduction of the cables, a competent corps of men take charge of the drawing in of the cables into the ducts, and I have prepared some sketches of the most essential tools, which I show in the drawings, Figs. 6, 7, 8, 9 and 10.

Moisture is to-day, as it has always been, the worst enemy of perfect underground construction, and therefore, in selecting men for the difficult work of making joints, it is well to secure those men who are possessed of that sovereign virtue, sobriety,



FIGS. 6, 7, 8.

and instill into their minds the fact that it is not how many joints they can make, but how well they can do them.

This class of men should be well paid and fostered, and I believe should be under the supervision of some one higher in authority than a mere boss line man. I am afraid that many, like Prof. Morse, tried the problem without experiment, and depleted pocket-books are silent reminders of that fact. But underground electrical construction is here to-day, and here to stay, and the success that now attends it is as signal as was its failure fifty years or more ago. Electrical currents of infinitesimal potential are no more easily conducted than are those electrical giants of four or five thousand volts. To-day the user of the cables for electric lighting simply tells the manufacturer of the potential, that he wishes to carry over his lines underground, and lo! the cable is forthcoming, and with it a guarantee. The telephone manager tells you that he must have a cable with an electro-static capacity that must not exceed a given number of microfarads, and that it

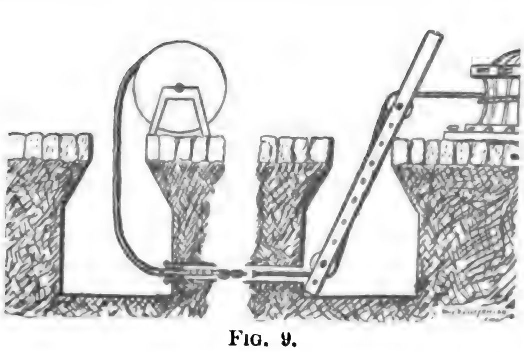


FIG. 9.

must contain so and so many conductors, and that its insulation must be so high and no higher, that all the conditions must be met within a given space, and the wires must be twisted in pairs, so that they can be formed into a metallic circuit if they wish, and your manufacturer goes at once to work and evolves a cable that meets these most exacting requirements. Thus on, through the whole list, transmission of power, telegraph, arc or incandescent lighting, it matters not, you simply make known your wants, aye, even whisper them, and twenty bright and active workers stand ready to take your orders, and deliver the results you desire.

Pardon my return to statistical information, but in the progressive city of Chicago alone, there is at present in successful daily operation the following enormous amount of underground electrical cables and wires, the telegraph companies alone using no less than 650 miles of wire. The Chicago Arc Light and Power Co. operate 140 miles of arc light cable and 30 miles of ducts. The city of Chicago 174 miles of arc light cables, 1,264,-430 feet of conductors, made into cables from 5 to 25 wires each, and 65 miles of single wires. The city has 20,441 feet of conduit

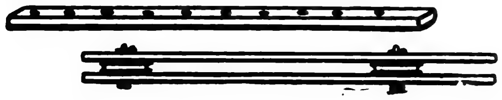


FIG. 10.

or about 100,000 feet of ducts otherwise than of iron pipe, and of the latter they have 478,087 feet used for conduits. The Chicago Telephone Co. have in operation at this date, 6,080 miles of wires, in the form of cables, or 32,102,400 feet of conductors. Their conduit system consists of 67,175 feet of main conduit, in which are 192,786 feet of duct. These conduits have a carrying capacity, when full, of 1,000,000 feet of cable, of 200 conductors. In addition to the above they have lateral conduits which measure 7,451 feet, and duct capacity in these laterals of 8,004 feet, and a cable capacity of a like amount. The Chicago Edison Company has 90 miles of conductors.

INSTITUTE DISCUSSION OF THE STANLEY ALTERNATING MACHINE.

The reading of the papers by Messrs Tobey and Walbridge and Mr. Thorburn Reid[1] on the new Stanley alternating arc machine was followed by an interesting discussion:

MR. WILLIAM STANLEY, JR., remarked that the papers referred to the regulation of a dynamo with which there is no external appliance to control the current. In applying an alternating potential to a circuit, there are two kinds of opposition to current flow. One kind is offered by the resistance of the circuit, determinate in the dimensions of the circuit, and the specific material of which it is composed, while the other is the opposition due to the shape of the circuit, that which we ordinarily call the self-induction of the circuit. Now the relation of these two oppositions to the flow of current is not exactly the same. The resistance of the circuit opposes the flow of the circuit at the instant the potential is applied. The counter-electromotive force of self-induction first delays the flow of current and then eggs it on, and the time that elapses between the application of a given potential to a circuit and the flow of current corresponding to any particular value of the potential is determinable by the ratio of the value of the self-induction to that of the resistance. Now, in the machine under discussion, we may consider that all that part of the circuit which is inside of the machine, viz., the armature coils, represents the self-induction part of the circuit. This portion, therefore, tends to delay the flow of the current for a while and afterwards to push it on. All that part of the circuit external to the machine may be considered to represent the resistance portion of the circuit. Now, it is evident we cannot change the number of turns of wire, or very well the number of revolutions of the machine when running; consequently we cannot change the value of the self-induction in circuit, and therefore the ratio of the self-induction to the resistance. The change of this ratio, by simply short-circuiting such arc lamps as we may wish to turn out, changes the time of the appearance of the current. It lets the armature of the machine get a little further ahead when one lamp is burning, when the maximum value of the current in the armature occurs; that is, it allows the armature pole to come up in front of the field pole, as shown in Fig. 10[2], and to oppose the field pole (the magnetization in the armature being directly opposite to that in the field), it keeps the lines of the field magnetism from passing through the armature. This effect is very beautifully shown by winding on the armature two circuits, one an arc circuit and another a few turns of wire connected with the voltmeter, both wound upon the same tooth. If the machine be short circuited, the magnetism is, as it were, blown out, and no potential is found upon the supplemental circuit. The whole regulation of the machine is due then to the fact that, as shown in Fig. 10, the time of the current flow has advanced, from the point AA of the horizontal line to the point near the numeral 5—13½. If we could put upon the field of the machine a separate circuit and as fast as we turned out the arc lamps that we wished to compensate for, put a current through that circuit, decreasing the field strength, we would obtain exactly the same results the machine attains by its own armature action.

MR. A. E. KENNELLY, in referring to the general idea embodied in Mr. Reid's paper, remarked that it was a method which is com-

1. THE ELECTRICAL ENGINEER, Nov. 5, 1890.
2. THE ELECTRICAL ENGINEER, p. 518, Nov. 5.

paratively new although not entirely so, of considering inductance in a dynamo not as a geometrical constant belonging to the wire or to the circuit, but as a function of magnetic resistance. Of course the two things were inseparably associated. The ordinary method, which is the shape method, which is supposed to be connected with the fact that an inductance is necessarily a length, is the original method. Any one who has tried to determine what the inductance of a coil is on theoretical grounds, or who has endeavored to follow the first formula given by Neumann for that determination which deals with an integral of little elements of length taken all around the circuit—each little part acting on every other part at a certain distance supposed to be measured or known and then multiplied by the cosine of the angle between those two elements—must feel that this treatment is exceedingly artificial and almost unnatural. He feels that although it yields a result which is correct, there is something there which suggests action at a distance, and not in a way in which nature herself must act. The other way, which deals with magnetic resistance, is a much more tangible one. It supposes a certain stress brought on the material, the resistance which that matter opposes to the magnetic force and the total effect of that resistance on the magnetic flux. The magnetic flux itself for unit current is then the inductance in the ordinary sense of the term. Consequently a method which will enable us to determine inductance from a simple conception of magnetic resistance must be immensely valuable, not only theoretically but also for the treatment of the most intricate problems which often present themselves for analysis. In continuous current machines, as Mr. Reid had pointed out, these reactions were few, comparatively simple, and more easily determined. In alternating current machines there are problems which baffle at present all the intelligence which can be brought upon them. Any means by which we can take a coil with any specified magnetizable environment and determine what the magnetic resistance of that circuit of environment will be, is most desirable; and he thought that any one who looks on this problem, however sadly he turns away from the fact that it is still a generally unsolved problem, must feel that there must be some means of attainment to this end, and of following out that plan by analysis.

MR. THOMAS D. LOCKWOOD referred to the fact that the very first machine employed for arc lighting, the "Alliance," was of the alternate current type and that likewise the first machine employed by Jablochkoff in his arc lighting system was of the alternating type.

MR. E. T. BIRDSALL inquired in what manner the efficiency was obtained from the curves of Messrs. Tobey and Walbridge's paper, and whether the efficiency takes into account the power used by the exciter?

MR. TOBEY, in reply, said that of the two values of E. M. F. and efficiency, the former were obtained first from the square root of the mean square; second, by taking the watt curve, the points of which were plotted from values obtained from the instantaneous values of current and E. M. F. These gave the instantaneous values of watts at different periods; then integrating the curve, they obtained the output in watts. In this manner, they obtained the value of the watts without determining either the E. M. F. or current. Dividing the watts by the current gave the second value of E. M. F. Of course the watts were the product of the E. M. F. and current, but were separated only as a matter of interest. The values of efficiency included the excitation. The method of getting these efficiencies was to divide the watts of electrical output by the sum of the watts by dynamometer, plus the watts of excitation.

MR. CHARLES STEINMETZ drew attention to the fact that while Mr. Reid assumed the magnetism of the field N to be constant, it was hardly ever so in practice, and in illustration of this referred to the variable nature of the exciting current as shown in the diagrams of Messrs. Tobey and Walbridge, there being fluctuations as great as 50 per cent. To complete the equations, there ought to be added to the term N, another factor, involving the amplitude of the variations of exciting current, and its angle of lag. He also thought that it would make a certain difference in the equations if the assumption of the constancy of magnetic resistance were abandoned, as not being quite true, and that here also another term ought to be added; but if this were done, the equations would become so complicated that it would hardly be possible to integrate them.

He saw the importance of this reasoning some time ago when testing a certain kind of alternator of about the same type as the new Thomson machine a short time before that machine was brought out. Here the induction was produced by changes of the magnetic resistance, and neither the armature coils nor the field coils were movable. By a calculation similar to the equations given, where he supposed the exciting current to be constant, and therefore the magnetomotive force of the field constant, also, he found an electromotive force of about 500 or 600 volts. But after experimenting with the machine, he obtained the very high voltage of 22 volts! (Laughter.) In this set of tests he used as an exciter the current derived from a storage battery of about 30 volts. Searching for the reason of this very curious phenomenon, and, suspecting the reaction upon the field current, he used an exciting current which was more likely to be constant, the current of a constant current dynamo, connected in series with a large storage battery and two transformers with open secondaries as choking coils, so that he was sure that very heavy self-induction and polarization straightened the wave of the exciting current. For exactly the same number of exciting turns and the same strength of current, and the same number of periods, the voltage of the dynamo rose to 160 volts. But this was still much lower than that calculated, so that this consideration seems to be rather important.

MR. THORBURN REID replied that he had gotten the equation (16) before it occurred to him that the field current would be variable; then, when he did think of it, he did not think it would be enough to amount to anything in changing the total magnetization. In regard to the change in the value of N, he saw that difficulty from the first. The saturation, of course, will change the value of N all the time. He concluded that the best plan would be to get an average value of N in different positions of the armature and for different values of the current. But as a theoretical matter to see how the machine regulates, he did not see how these two considerations would materially affect it.

MR. C. O. MAILLOUX remarked that the reactions of the magnetic field are constantly causing a succession of fluctuations, even in continuous current machines. If it is a shunt machine, that effect is only felt on the shunt circuit. If it is a series machine, it reacts over the whole circuit. Each time a section is commuted, or, in an alternating current, each time there is a reversal, there is a re-distribution of the magnetic field. Just previous to the time when the section is about to go out of circuit or is going to have its current reversed, there is a certain tension in the magnetism at, or about, the neutral line or at the space corresponding to the portion occupied by that coil that is ready to pass out; and at the very instant that the current is reversed in that section, there is a re-distribution. We have a certain relapse, so to speak, of the lines of force. Now this necessarily affects magnetic resistance since the path of the lines of force is altered in length. He had also had occasion to study this fluctuation in a more perceptible way, on a larger scale, in connection with the older form of machines formerly in use, with the old shuttle-wound armatures of the Siemens type. When they are used for producing continuous currents, we get, strictly speaking, not a continuous current, but a series of alternated impulses. We have really a large impulse in one direction followed by a smaller impulse in the opposite direction, in each case, so that the current is only relatively continuous in spite of the commutation. He had seen machines of that type, where, by putting another coil around the magnetic field an alternating current could be obtained which could be used for producing electric light, working transformers, etc., showing that in this case the oscillations or the wavy action taking place in consequence of the reactions of the armature on the magnetic field, were sufficient to determine a motion of a magnitude adequate to produce the induction of a current in a suitable circuit. In this connection he wished to invite those who study these matters from the mathematical standpoint to consider in connection with their treatment the fact that the elasticity of the lines of force themselves is a reactionary factor of importance in the phenomena taking place while currents are being induced by the cutting of lines of force. In expressing inductance we have to introduce the notion of velocity since the E. M. F. due to self-induction varies with the rate at which lines of magnetic force are cut. Now the notion of velocity must involve the consideration of the fact that the lines of force themselves are not passive during the operation of being cut; that they may yield one way; that there is a certain tension produced by the reaction of the current which would make them give way, as Mr. Stanley has so well said. Now in that case the velocity would evidently be affected and the rate of cutting would be reduced; while in the rebound they would fall back, and thereby increase the relative velocity or rate of cutting.

DR. M. I. PUPIN drew attention to the peculiar form of the curve which expresses the electromotive force; when arc lamps are introduced in the circuit it is evident that the form of the curve is entirely different from the form which obtained when there are incandescent lamps in it. Mr. Tobey had suggested that it was probably due to the change of resistance brought about by the cold air which is cooling off the carbon points, and the experiment which he devised to test this, seemed to prove his suggestion. But there was another way of looking upon this matter and that was this: We know that the current is conveyed between the carbon points by means of luminous carbon particles. The resistance between the two carbon points depends on the amount of this luminous carbon particles which pass between the points. Now, the amount of these luminous carbon particles depends on the strength of the current, just as in electrolysis the amount of an element deposited depends on the electric current. Therefore the resistance will change with the current. When the current is zero the resistance will have a maximum; and vice versa. In addition to that, we have, of course, changes due to the change in the temperature of the carbon point. Now, Messrs. Tobey and Walbridge introduced the flame of an alcohol lamp between the two points and observed that the sharp corners in the curve were modified, rounded off. But the flame is, comparatively speaking,

a very good conductor of electricity, so that by putting a flame between the two carbon points, in order to prevent, as they intended, cold air from rushing in, they had introduced a good conductor there and had prevented those large variations in resistance and had thereby prevented sudden changes in the electromotive force.

He did not agree with Mr. Kennelly's suggestion that it was desirable to introduce magnetic resistance in the definition of self-induction, so that we would have something tangible, whereas the definition of self-induction as given by Neumann was a mathematical one and intangible. His reason for this was that Neumann's integral for the coefficient of self-induction represents a certain physical quantity which can be measured. It refers to the electro-magnetic energy of the field, and energy is the best conception to have. He did not know what the magnetic resistance was. He could not imagine anything that could represent magnetic resistance, unless to establish first the relation between this quantity and the electro-magnetic energy. The integral of Neumann represents a certain amount of energy which we can measure in a great many ways. Referring to Mr. Steinmetz's remark that if we introduced N as variable we would obtain a differential equation which is not integrable, he did not agree with him in this particular case, for the simple reason that N would be a quantity which varied in a certain way and has two points of discontinuity during one revolution. It was a periodic function, having the same period as the machine, and every function of that sort can be represented by a series of sines and cosines. Besides, the curves obtained were practically sine curves; therefore, we have every reason to infer that the magnetic resistance will be a simple harmonic function, and that this is equal to a constant plus a sine function.

Dr. Cary T. Hutchinson did not see how Mr. Reid's equations differed from the ordinary well known forms based on the assumption of a sine curve variation and constant magnetic permeability. In their paper, the authors had given several diagrams of magnetic circuits, and based certain explanations upon those diagrams; in Figs. 4 and 5 the lines of induction pass through the armature and back entirely by air. Where was the return part of the circuit? It certainly was not completed through the air, as shown. Referring to the definition of the coefficient of self-induction, was not one of the simplest definitions: The number of lines of induction enclosed by the circuit? This, of course, included the case both of air and iron, and took into account very plainly the reluctance. Again, he did not see how the reluctance of the circuit could be a simple sine function, for the reason that the air gap formed the largest part and was constant.

Dr. Pupin replied that he did not say that it was the same sine function. He said magnetic resistance was a simple harmonic function. Of course, magnetic resistance was connected with self-induction, but it did not follow at all that the coefficient of self-induction will be a single sine function.

Dr. Hutchinson drew attention to the fact that Dr. Louis Dundan, of Johns Hopkins University, and two associates, had made some experiments of this kind nearly three years ago; the curves shown might almost be taken as tracings from some of theirs, and the description of the method and apparatus used in obtaining them applied almost verbally to their method and apparatus. This was the more remarkable, as neither in this paper, nor in Prof. Ryan's read before the Institute some time ago, and which was even closer to Dr. Duncan's than this one is, as both dealt with transformers, was there the slightest reference to their work. Their experiments were made on a Siemens dynamo using both open and closed circuit transformers. Nor did they find any difficulty in the direct use of a Thomson quadrant electrometer.

AN ELECTRICAL COMMISSION FOR WASHINGTON.

The President of the United States has appointed Lieutenant Francis R. Shunk, corps of engineers; Professor Henry A. Rowland, of Johns Hopkins University, and Andrew Rosewater, of Omaha, Neb., a board "to consider the location, arrangement and operation of electric wires in the District of Columbia, whether used for electric lighting, transmission of power, telegraphy, telephony or signaling, with a view to procuring as soon as practicable the construction of a safe and convenient system of conduits or subways, and the placing therein of all necessary electric wires along the streets, avenues and other public places and the removal of all unused overhead wires and their supports," as provided for in the District of Columbia appropriation bill of 1890.

The "Chicago Journal of Commerce," which has long been published as a blanket sheet, has now changed its form and appears in a "make-up" very similar to that of The Electrical Engineer, adding also a handsome cover. The change is decidedly one for the better in every respect, and serves to bring out the many excellent qualities of the journal in higher relief. We trust the Journal may enjoy great prosperity as a quarto.

EUROPEAN CORRESPONDENCE.

LONDON.

Newspaper Office Lighting.—An Explosion.—Underground Mains.—Dynamo and Engine Efficiency.—Lighting of Monte Carlo.—New Fog Signal.

An electric light installation for the new offices of the *Bolton Evening News* has been completed by Messrs. Ernest Scott & Co. It claims to be one of the most complete plants erected in newspaper offices; 300 16 c. p. lamps and one of 200 c. p. and 100 c. p., respectively, are supplied from two "Tyne" dynamos. Each machine is constructed to give an output of from 90 to 100 amperes at an E. M. F. of 105 volts, the speed being 900 revolutions. Gas engines are employed for the motive power. The switch-board is an enameled slate slab of 5 feet by 4, completing a handsome piece of work.

One of our leading daily papers takes account of an explosion which took place on board Earl Poulett's steam yacht while stationed at Portsmouth. On striking a light in one of the cabins to discover the source of a leak, a loud explosion took place. On the Earl and his engineer going on deck where the accumulators were kept for supplying light to the boat, it was found they had burst and were smashed to atoms. This, although a somewhat rare occurrence, has happened before; a similar accident took place not very long ago on the Barking Road tramway here, when the windows and light woodwork of the cars were broken. The former may be accounted for by the fact that although the accumulators were on deck they were provided with exceedingly small vent holes. Mr. Anthony Reckenzaun, having in mind this mishap, says that he experienced explosions with covered cells having vent holes, as early as 1882, and at different periods since. It is well known that if there is a sufficient supply of air or the cells are completely sealed or quite open at the top, there will be sufficient safeguards against mishaps of this description. Of course it is natural to suppose that overcharging of storage batteries must of necessity evolve hydrogen which, accumulated in a close atmosphere, will produce a most explosive compound.

We are likely to have some small quarrels here on the question of mains, between the Board of Trade and the vestries. On the former authority granting a provisional order to a company, it is naturally supposed that no further obstacles will be placed in the way. Vestries, however, do not thus look on the matter, and last week the secretary of the London Electric Supply Co. was summoned by the vestry of St. George, the Martyr, for cutting away a sewer for the purpose of laying mains. The matter was adjourned in order that the Board of Trade may take this as a test case.

Various tests have been published from time to time of the efficiency of Willans & Robinson's central valve engine combined with various dynamos. Last week a test was made with an engine combined with a large Edison-Hopkinson dynamo, made by Mather & Platt, and a result was obtained superior to anything previously reached, the figures being 86.7 per cent.

Monte Carlo will shortly be lighted by electricity, the central station being in course of erection. Two alternating current machines of the Zipernowsky type, A6, together with the necessary exciters and transformers are already set up, and a third machine will shortly be added.

A successful trial of a new fog signal has been carried out on the Great Northern Railway. It is the invention of Mr. Andrews, an electrician of Nottingham, and does away with the old fashioned and noisy fog signals. The principal features are an insulated rail laid down in parallel with the ordinary rail. The current is conveyed to the engine and signal box by means of a metallic brush affixed to the footboard. An illuminated dial is fixed on the weather-board of the engine, with a miniature signal and a gong to direct the attention of the driver to the sign given on the engine. The action is automatic and is not affected by the rate of speed of the train.

London, Oct. 28, 1890.

Town Lighting.—South London Railway.—City of London.—Electric Traction.—Progress in Vienna.—Edinburgh Exhibition.—Submarine Telephone Experiments.—Paris Telephone Service.—Bradford Electric Lighting.—Lighting in Coal Mines.—New Electrical Journal.—Mr. Lane-Fox's Patent.—The Old Students Association.

The corporation of Sunderland, after considering an exhaustive report on the electric lighting of the town furnished by the appointed committee, has decided to apply to the Board of Trade for a provisional order to enable it to supply electricity. It is estimated that 10,000 c. p. will be provided for. The towns of Southport, Exeter, and Whitby will be lighted from stations of the local authorities.

Something definite is at last to hand regarding the South London Railway, which, as I have mentioned previously, is the new electric railway running from London Bridge to Stockwell.

For months information has been vainly sought, but it seems that we are about to have our wish. The Prince of Wales is announced to formally open the railway next Tuesday, Nov. 4th, when everybody will have the opportunity of criticising the work which has been so jealously guarded.

The authorities controling that district in London known as the City, are advertising for tenders for the lighting of an area which includes all the principal publishing and newspaper offices. It is said this will be one of the most profitable parts, as the gas bills are enormous.

The North Metropolitan Tramway Company are anxious to place twelve electric cars upon their lines, but one of the vestries with its usual cry of "the infancy of electricity" has contrived to interpose many obstacles. The matter is to be referred to the County Council, and as this is a progressive body, I have little doubt as to the result.

There are not wanting many signs of progress in Vienna. A scheme has been submitted for a complete transformation of the tramway system, the major portion of the lines to be worked by electricity. It is also intended to construct an underground narrow gauge railway, which would cross the town in two directions, so that passengers would be able to journey from one side to the other in five minutes, a three minutes' service of trains being proposed.

The Electrical Exhibition of Edinburgh has been a financial failure. It is computed that the deficit will be about £30,000.

Heligoland has not long been in the possession of the Germans, but short as the time has been, it has enabled the Imperial Government to carry on interesting experiments of telephony in submarine cables which have been particularly satisfactory. Telephonic communication has been established between Heligoland and Cuxhaven, a distance of 46 miles.

The unsatisfactory telephone service in Paris is about to be improved. The government intends to centralize the wires in a large building which will be constructed in the very heart of the city.

A report recently issued by the Bradford Corporation considers the electric lighting in that town a great success. This is the only municipal body, with the exception of one, which has undertaken the responsibility of supplying electric light. The plant was laid down in September of last year. Since then there has been a constantly growing demand. To meet this, two more dynamos will shortly be placed in position.

Colliery owners here are very slow to utilize electricity, although when it is used it is a signal success. Last week, however, arrangements were begun by the Fife Coal Company for the introduction of the electric light into their pits at Leven, N. B., which will obviate the necessity of each miner carrying his own lamp. It is specially intended to light the roads of the mines, the lamps being placed about fifteen yards apart.

A new weekly electrical journal is to be published next month at one penny. The name of the new journal will be *Electricity*. It will be edited by Dr. Maier.

Mr. St. George Lane-Fox is trying to enforce his claim to "the employment of secondary batteries as reservoirs of electricity in combination with a mode or system of distribution such as is hereinbefore explained." This is the claim to his patent specification No. 3988 * * of 1878, and everybody using secondary batteries in combination with dynamos and lamps in parallel is threatened with legal proceedings, unless the user is prepared to pay him a royalty. The English technical press is taking the matter up, and it is believed that the claims put forward on behalf of Mr. Lane-Fox will be shown to be absurd. After all it was nothing but a method of connecting up existing apparatus which anybody would naturally try, and I scarcely think that this will be held as patentable. Anyway there seems every probability of lively times for the legal profession.

Mr. W. B. Esson, the newly appointed president of the Old Students Association of the City & Guilds of London Institute, and who is one of the greatest authorities on this side on dynamo electric machinery, will deliver a most elaborate address next week on "Industrialism." It is expected it will command great attention.

H. S.

LONDON, Oct. 29th, 1890.

AN ELECTRICAL CHAIR FOR INVALIDS.

An electrically propelled chair for invalids has been designed by J. V. Sherrin. The chair is of wicker work, weighs 200 pounds and is mounted on wheels of the tricycle type. The primary cells, eighteen in number, weighing 80 pounds, are suspended from the rear wheels. The motor, a modified two-pole Gramme machine, with laminated field magnets, has a uniform output of ¼ horse power. Properly charged, the battery is capable of propelling the chair over an ordinary road for nine hours at the rate of about six miles per hour. It is easily steered and stopped, and can be charged each time for about ten cents.

CORRESPONDENCE.

ST. LOUIS.

The Power Plant of the Union Depot Railroad.—The Mound City Electric Railway.—Removal of Electric Wires From the Streets.

THE 1000 h. p. addition to the power house of the Union Depot Railroad is rapidly approaching completion. One of the 500 h. p. Hamilton-Corliss engines is set up and in use, and the other one is being set up. The 14 additional 80 h. p. generators are on hand and being placed in position. Three of them are finished and in use. In the boiler house two additional Heine patent safety boilers, each of 250 h. p. capacity, have been set up, and a new brick smoke-stack, 162 feet in height, has been erected. Everything is expected to be finished and in readiness for supplying current to the Mound City Railroad by the middle of November.

A large machine shop for repairs and manufacture of everything pertaining to maintenance and operation of the road is being erected. The loop to Union Market via Broadway to Lucas avenue and returning on Sixth street to Pine street was finished and put into operation this week.

The Mound City Railway will have their overhead electrical equipment finished by the middle of November; 25 motor cars are being built for them by the St. Louis Car Co., a part of which are now finished and in use temporarily on the Union Depot road. The Mound City road will be supplied with current from the power house of the Union Depot Railroad, which is located over a mile away from their line, a separate system of feed wires being used for the purpose.

At a meeting of the Board of Public Improvements, last Tuesday, the committee on city lighting was instructed to prepare and report a plan for the removal of electric wires from the streets in the business district. This action of the Board was brought about by a complaint from the Chief of the Fire Department, that at a recent fire the working of the firemen was seriously interfered with by the breaking and crossing of a number of telephone and telegraph wires with electric light and power circuit wires of the street railways.

The Lindell Railway Co. have introduced a bill before the Municipal Assembly authorizing them to construct a branch line on Mississippi avenue, Park avenue and Vandeventer avenue to Tower Grove Park.

The Western Union Telegraph Co. have let contracts for the alteration and fitting up of the Lucas building for their new quarters.

ST. LOUIS, October 29th, 1890.

PITTSBURGH.

A Fitting Reward for Folly.—Electric Railway Work.

ROBERT WASHINGTON, a colored man, was instantly killed by a shock from an arc light circuit at the Edgar Thomson Steel Works, in Braddock, Pa., on the night of October 30th. The accident was the result of a foolish piece of bravado. Washington was known among the men at Carnegie's blast furnaces as a venturesome and foolhardy young man. He took a special delight in catching hold of electric wires, when the current was off, and he would laugh when somebody warned him that he might one day find himself holding on to a charged wire. That night, while standing in the Carnegie blast furnaces, young Washington said he was not afraid of electrocution, and reaching high over his head, he grasped the arc lamp above him. He fell instantly to the floor, and when he was picked up by the men who only a few minutes before had been laughing at his attempted joke, Washington was found dead. Across the palm of his right hand was a scar, burned deep in the flesh. It was the exact shape of that part of the lamp he had caught hold of and was blackened to a crisp.

The Wheeling Electric Railway Co. has purchased the electric poles, wires and the power generators of the Wheeling Electric Co. which were formerly only rented by the street railway people. It is also stated that these two concerns are now negotiating for a consolidation of interests.

The corner stone for the new power-house of the Pittsburgh, Allegheny and Manchester Electric Street Railway Co. has been laid. According to the contract of the company, the foundation is to be ready for the placing of the engines and motor generators by Feb. 15, 1891.

There have been a good many delays in the construction of the electric railway line of the Birmingham Traction Co., which have hitherto greatly handicapped the company from getting the road started. Among other things, the company had to build an addition to the Smithfield street bridge, in order to make that structure suitable for the traversing of the electric cars. However, all the difficulties seem to have been overcome now. The wires are about all strung and it is the company's intention to have the cars running the first week of December. While the power-house

and the machinery are not in shape yet, the company will use the power, for the operation of its cars from the Allegheny County Light Company.

An electric street railway company is now being organized by a number of capitalists from Braddock, McKeesport and Wilmerding, for the purpose of constructing an electric street railway between McKeesport and Wilmerding.

PITTSBURGH, Oct. 31, 1890.

BOSTON.

Britishers Visiting the Lynn Factories.—Arguing for the Elevated Road.

ANOTHER delegation of visitors, representing the Iron and Steel Institution of Great Britain, visited Boston and Lynn this week, and were the guests of the Thomson-Houston Electric Company, and the Thomson Electric Welding Company. The party, who came from Canada, were met at Lowell by Messrs. C. H. Richardson and Mr. F. R. Royce, and on their arrival in this city were taken under the protection of a reception committee, consisting of James M. Meech, H. N. Sweet, H. C. Spaulding, P. L. Saltonstall and C. B. Davis. After lunch, which was served at Young's hotel, the visitors were taken to Lynn, where they spent the afternoon in inspecting the factories of the Welding Company and the Electric Company, the greatest possible interest being taken in the various processes of electric welding.

The hearing on the extension of Harrison avenue for the elevated railroad was continued on Saturday last before the street commissioners. The Hon. William G. Russell presented the case for the West End Street Railway Company, and ably met all the arguments of the remonstrants. He clearly proved the necessity of an elevated railroad, discussed the merits of the route proposed, and warmly defended the plans of the West End Company.

CHICAGO.

The South Side Elevated Road.—Congressman Allan C. Durburrow.—Hyde Park Lighting.

THE Chicago and South Side Rapid Transit Co., who are building the alley elevated road, are pushing the work on their main line rapidly along and those at the head of the enterprise expect to have trains in operation by next spring. The stations now being built differ materially in their construction from those in use in New York. As the road runs in an alley instead of a street the stations will be on the ground instead of on a level with the elevated structure. The passengers after purchasing tickets will ascend by means of stairways to platforms beside the tracks. Sheltersheds of light construction will be erected over these platforms. The stations are of an attractive design and will be built of pressed brick, trimmed with granite and terra-cotta, and cost about $15,000 each. Tickets will not be taken on the train, as the passenger will be required to give up his ticket before ascending the stairs to the train. According to the company's plans trains can be run with safety one minute and a half apart, when for any reason traffic is unusually heavy. It is not unlikely that electricity will be used as the motive power and it is certainly to be hoped that this will be the case, as any additions to the present smoke nuisance would be unbearable, and this point is but one of the great advantages of electricity over steam for railway work.

Mr. Allan C. Durburrow, the well-known business manager of our contemporary, *The Western Electrician*, has been elected to Congress in the Third district, as a Democrat, by a majority of 2,593 votes. I heartily congratulate him upon his success and expect to see him win many further honors in the field of politics.

The Hyde Park Thomson-Houston Electric Light Co. are now very busy supplying incandescent lights in private residences. They are charging moderate prices, and this class of their lighting business is growing very rapidly. It is encouraging to note the way the electric incandescent lamp is forcing its rival gas even from private residences.

CHICAGO, Nov. 6th, 1890.

BROOKLYN INSTITUTE—BATTERY EXHIBITION BY THE ELECTRICAL DEPARTMENT.

The electrical department of the Brooklyn Institute, gave a very interesting exhibition of batteries Oct. 31. Every form, from the gravity, Grenet and the different types of Leclanché and dry cells to the Edison-Lalande accumulators, was represented.

Among those most attractive were the Electrical Accumulator Company's four small accumulators driving a fan with one of the Electro-Dynamic Company's small motors, and illuminating seven small incandescent lamps; and two cells of Law battery working an elaborate outfit of medical coils.

The New Haven Clock Company presented their exhibit of dry and carbon batteries, electric bells and telegraph sounders to the department.

REPORTS OF COMPANIES.

THE EDISON TOY MFG. CO.

The annual meeting of the Edison Toy Manufacturing Company was held at Portland, Me., on Oct. 30, 1890. Mr. Edison was represented by his secretary, Mr. Tate. This was the treasurer's exhibit Sept. 30:

LIABILITIES.

Capital stock	$1,000,000.00
Working capital	62,871.87
Total	$1,062,871.87

ASSETS.

Treasury stock	$160,000.00
Licenses and patents	846,894.84
Cash	2,978.08
Cost of dolls' parts and merchandise	35,384.23
Edgar S. Allen, general manager	69,025.00
European expense account	5,699.84
Thomas A. Edison	1,000.00
Office furniture	1,289.18
Total	$1,062,871.87

These officers were elected:—Directors, Benjamin F. Stevens, Daniel Weld, John W. Mackintosh, Winfield S. Hutchinson, Thomas A. Edison, George Borgfeldt, Oscar E. Madden; clerk, Clarence Hale; treasurer and secretary, Daniel Weld.

Mr. Edison is the only creditor of the company—for about $50,000 to $57,000. The company is capitalized for $600,000, in 60,000 $10 shares. It has 16,000 shares in the treasury, and has received about $600,000 in money for the remaining 84,000 shares.

ERIE TELEPHONE CO.

The Erie Telephone Company will pay a dividend of one per cent., November 17, to stockholders of record Nov. 8. The combined report of the Cleveland Telephone Company, the Northwestern Telephone Exchange and the Southwestern Telegraph and Telephone Company for the quarter ended Sept. 30, and the first half of the current fiscal year, is as follows:

QUARTER ENDED SEPT. 30.

	1890.	1889.		
Gross	$195,903	$178,526	Inc.	$17,377
*Expenses	140,082	119,911	Inc.	20,171
Net	$55,821	$58,615	Dec.	$2,794
Dividends	48,000	48,000	Inc.	....
Surplus	$7,821	$10,615	Dec.	$2,794

FIRST HALF FISCAL YEAR, APRIL 1, TO SEPT. 30.

	1890.	1889.		
Gross	$385,296	$355,614	Inc.	$29,682
*Expenses	271,632	238,583	Inc.	33,049
Net	$113,664	$117,031	Dec.	$3,367
Dividends	96,000	96,000		......
Surplus	$17,664	$21,031	Dec.	$3,367

*Includes construction and dividend on the Bell company's stock.

SUBSCRIBERS ADDED.

	1890.	1889.		
Quarter ended Sept. 30	276	138	Inc.	138
Total connected Oct. 1	12,938	11,702	Inc.	1,236

The Erie Company received $4,290 surplus from its sub-companies after paying its dividend, making the total surplus for the quarter $12,111.

GROWTH OF A MINNESOTA ELECTRIC PLANT.

The Superior Water, Light & Power Co., of Duluth, Minn., which has a capital stock of $1,000,000, has been obliged again to increase its capacity. It controls the gas plant, electric light and power plant, and the water works. Mr. John Mather, the general manager, writes us:—"On Nov. 1, 1889, our electric plant consisted of one 35 light Western Electric arc machine, and 4 Daft dynamos of 50 h. p. for incandescent lighting. We have to-day four 50 light Thomson-Houston arc machines, besides the above, and one 1500 light Westinghouse alternator, as well as two 80 h. p. Thomson-Houston generators with which we furnish current to the street railway, and 50 h. p. of stationary motors. Notwithstanding the great increase in our machinery, we have now again almost reached our full capacity, and have placed orders for another 1500 light alternator and another 80 h. p. generator, both of the Thomson-Houston make." The company has about 50 miles of circuit, of which about two-thirds is underwriter, the remainder being K. K. and Candee. The plant is run by a 400 h. p. compound condensing Buckeye engine, and two 125 h. p. Buckeyes, with Babcock & Wilcox boilers of corresponding capacity. The company, which is certainly to be congratulated upon its remarkable growth, has A. H. Wilder, as president; V. M. Watkins, vice-president; F. A. Ross, secretary, and J. Mather, general manager.

FINANCIAL MARKET.

QUOTATIONS ON ELECTRICAL STOCKS.

F. Z. Maguire & Co., Electrical Securities, of 18 Wall street, this city, report the following quotations of November 8th, from New York, Boston and Washington:

NEW YORK.

	BID.		BID.
W. U. Tel. Co.	79⅛	Edison Gen. Elec. Co.	90
American Tele. & Cable	83	Edison Gen. Co. Def'd	82
Centl. & So. Amer.	155	Consol'd Elec. Lt. Co.	...
Mexican	208	Edison Illn'g Co. N. Y.	67
Com. Cable Co.	101¼	U. S. Elec. Lt. Co.	30
Postal Tel. Cable	39	North Am. Phonograph	35

*Ex. Dividend.

BOSTON.

	BID.		BID.
Thomson-Houston	46	Ft. Wayne Co.	12¼
" Pref'd	27	Am. Bell	220
" Series C.	11¼	Erie	48¼
" " D.	6¾	New England	51¼
" Int. Co.	....	Mexican	.77¼ cts
Thomson Welding Co.	185	Trop. American	..
Thomson Eu. Welding	....	Edison Phon'gph Doll	2

WASHINGTON.

	BID.		BID.
Penna. Telephone	26	U. S. Elec. Lt (Wash.)	150
Ches. & Pot. Telephone	68¼	Eck. & Sold. Home Elec. Ry.	60
Amer. Graphophone	13¼	Georgetown & Tenallytown	48

*Ex-Dividend.

PITTSBURGH.

	BID.
Westinghouse Electric and Manufacturing Co.	26¼

LEGAL NOTES.

CARLIN vs. WEST END RAILWAY, BOSTON.—INJURY TO PASSENGER.

An important suit was decided in the Superior Court, Judge Thompson, last month, in which one Carlin sought to recover $10,000 from the West End Street Railway Company, of Boston, for injuries received while attempting to board an electric car in Cambridge. The plaintiff testified that he signaled the car to stop at a point between the stations where it regularly stopped; that the car slowed up, but started ahead with a jerk just as he was about getting on board. At the conclusion of the plaintiff's testimony, Judge Thompson ordered the jury to find a verdict for the defendant. The ground taken by the court was that no one had a right to get on a car except when it had stopped at its regular stations, and that between stations the car was liable to start ahead with a jerk at any moment, the driver being justified in thinking that no one was getting off or on.

ELECTRICAL EXECUTION IN THE U. S. SUPREME COURT.

The Supreme Court of the United States has granted the motion to advance the case of Suibuga Jugigo, who is under sentence of death by means of electricity in New York State, and assigned the case for argument on the third Monday in November, after the cases already set down for hearing on that day.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

At a meeting of the Executive Committee held at the Electric Club, New York City, Nov. 7, the following business was transacted:—

The date for holding the Thirteenth Convention was fixed for February 17, 18, and 19, 1891.

Eugene F. Phillips, of Providence, was appointed chairman of a committee of five, on Reception and Arrangements, he to appoint the other members of the committee.

Gen. C. H. Barney, of New York, was appointed chairman of a committee of three on Electrical Exhibits and Transportation, he to appoint the other members of the committee.

The committee on Papers reported the following as promised, and stated that the prospects of securing two or three more important papers are most excellent. Announcements of these will be made later. The committee has not only secured the promise of these papers, but has gone a step further, and named a person to open the discussion on each paper. This must inevitably tend to bring out the best points of the topic and to greatly add to the interest in, and value of, the proceedings.

(*a*) How Can the National Electric Light Association Best Serve Central Station Interests? by C. R. Huntley. Discussion by A. M. Young.

(*b*) Distribution of Steam from a Central Station, by F. H. Prentiss. Discussion by George H. Babcock.

(*c*) Distribution and Care of Alternating Currents, by T. Carpenter Smith. Discussion by G. H. Blaxter.

(*d*) Municipal Control of Electric Railroads, by M. W. Mead. Discussion by M. J. Francisco.

(*e*) The Ferranti System, by C. B. Haskins. Discussion by C. L. Edgar.

The resignation of Mr. James English as a member of the Executive Committee was accepted, and Mr. Edward A. Leslie, manager of the Manhattan Electric Light Company, of New York City, was elected to fill the vacancy.

INVENTORS' RECORD.

Patents issued October 28, 1890.

Alarms and Signals:—*Railway-Truck Electrical Annunciator*, J. W. Lattig, 439,409. *Fire-Alarm or Fire and Heat Indicator*, C. W. Summerskill, 439,441. *Burglar-Alarm*, J. J. Griffith, 439,503.

Distrubution:—*Electric Lighting System*, T. A. Edison, 439,389. *Electric Lighting System*, T. A. Edison, 439,390. *Junction-Box for Electric Wires*, T. A. Edison, 439,391. *Electric Lighting System*, T. A. Edison, 439,392. *Automatic Regulator for Electric Currents*, W. Morrison, 439,417.

Dynamos and Motors:—*Electric Motor*, C. S. Bradley, 439,102. *Synchronous Alternating-Current Electric Motor*, C. Zipernowsky, M. Déri, and O. T. Bláthy, 430,459.

Electro Medical Apparatus:—*Electro Dental Heater*, L. A. Faught, 439,238.

Galvanic and Thermo-Electric Batteries:—*Dry Battery*, W. L. F. Hellesen, 439,151. *Porous Cup for Galvanic Batteries*, C. A. Hussey, 439,516.

Lamps and Appurtenances:—*Repairing Incandescent Electric Lamps*, C. Pauthonier, 439,178. *Electric-Lamp Socket*, J. O. Phillips, 439,304. *Electric-Lamp*, A. Swan, 439,363. *Incandescent Lamp Socket*, A. Swan, 439,364. *Incandescent Lamp Socket*, A. Swan, 439,365. *Incandescent Electric-Lamp Socket*, A. Swan, 439,366. *Incandescent Electric-Lamp Socket*, A. Swan, 439,367. *Adjustable Lamp-Standard*, O. Luetke, 439,411.

Measurement:—*Electric Meter*, W. H. Bristol, 439,381.

Miscellaneous:—*Electro-Magnetic Clutch*, C. H. Veeder, 439,213. *Electric Elevator*, F. B. Perkins, 439,180.

Railways and Appliances:—*Trolley-Arm Guide*, A. F. Bardwell, 439,092. *Power-Gearing for Cars in Train*, A. R. Cavner, 439,108. *Trolley-Pole*, L. Pfingst, 439,182. *Trolley-Pole for Electric Cars*, B. C. Rowell, F. E. Galloupe, 439,192. *Apparatus for Transferring Electric-Car Batteries*, F. G. Corning, 439,237. *Electric Railway*, L. Westerland, 439,262. *Automatic Wire-Finder for Trolley-Heads*, G. S. Slocum, 439,308. *Electric Locomotive*, F. W. Dean, 439,345. *Mechanism for Operating Street Car Switches*, W. A. Lee, 439,354. *Electric Railway*, C. Richter, 439,428. *Electric Motion-Transmitter*, M. W. Dewey, 439,577. *Electric Railway Motor Car*, E. Wagemann, 439,584. *Electric Railway Conduit*, R. M. Hunter, 439,597.

Storage Batteries:—*Method of and Apparatus for preparing Electrodes for Secondary Batteries*, C. D. P. Gibson, 439,240. *Secondary Electric Battery*, J. F. Mehren, 439,301. *Secondary Battery*, E. J. Mason, 439,334. *Making Storage Battery Plates*, W. Morrison and L. Schmidt, 439,416. *Secondary Battery*, W. B. Hollingshead, 439,594.

Telegraphs:—*Perforater for Automatic Telegraphing*, F. D. Mack, 439,164.

Telephones and Apparatus:—*Mechanical Telephone*, H. M. Chamblin, 439,475.

Patents issued Nov. 4, 1890.

Alarms and Signals:—*Street or Station Indicator*, L. Goldstone, 439,941. *Electrical Indicator*, L. O. Chatfield, 440,013. *Electrical Burglar-Alarm*, F. Pierce, 440,115.

Clocks:—*Electric Actuating Device for Pendulum Clocks*, J. H. Dyson, 439,838.

Conductors, Conduits and Insulators:—*Guide for Machines for Covering Wires*, J. McCahey, 439,675. *Insulating Composition*, T. D. Bottome, 439,796. *Insulator for Electric Conductors*, W. Kessler, 440,042.

Distribution:—*Methods of and Apparatus for Connecting Dynamos*, C. T. Childs, 439,979.

Dynamos and Motors:—*Electric Motor and Generator*, A. Gartner, 439,775. *Electrical Generator*, F. L. McGahan, 439,974. *Automatic Regulator for Dynamos and Motors*, F. J. Cleaver and G. Fassold, 440,016.

Galvanic and Thermo-Electric Batteries:—*Standard Galvanic Cell*, E. Weston, 439,737.

Lamps and Appurtenances:—*Electric-Arc Lamp*, H. C. Shubert, 439,904.

Miscellaneous:—*Electric Heater*, C. W. Drew and E. R. Francis, 439,724. *Electric Log*, W. P. Granville, 439,840. *Rheostat*, E. R. Gilbert, 439,939. *Magnetic Separator for Grain*, E. von Syo, 440,070. *Electric Heater*, C. H. Talmage, 440,071.

Railways and Appliances:—R. M. Hunter, 439,662. *Trolley-Line Switch for Overhead Electric Conductors*, W. L. R. Emmet, 439,746. *Electric Railway*, M. W. Dewey, 439,867. *Adjustable Trolley and Guard for Electric Wires*, L. S. Hoyt, 440,106.

Secondary Batteries:—*Secondary Battery Plate*, A. E. Woolf, 439,850. *Electrode for Secondary-Batteries*, J. B. Entz and W. A. Phillips, 440,023. *Method of Making Electrodes for Secondary Batteries*, J. B. Entz and W. A. Phillips, 440,024.

Telegraphs:—*Telegraph-Key*, W. A. J. Kohrn, 439,959.

Telephones and Apparatus:—*Holder for Telephone Receivers*, F. T. Tinning and W. K. S. Tinning, 440,091. *Telephone*, S. Bergmann, 440,096. *Automatic Toll System for Telephone Pay Stations*, H. C. Root, 440,118.

TRADE NOTES AND NOVELTIES

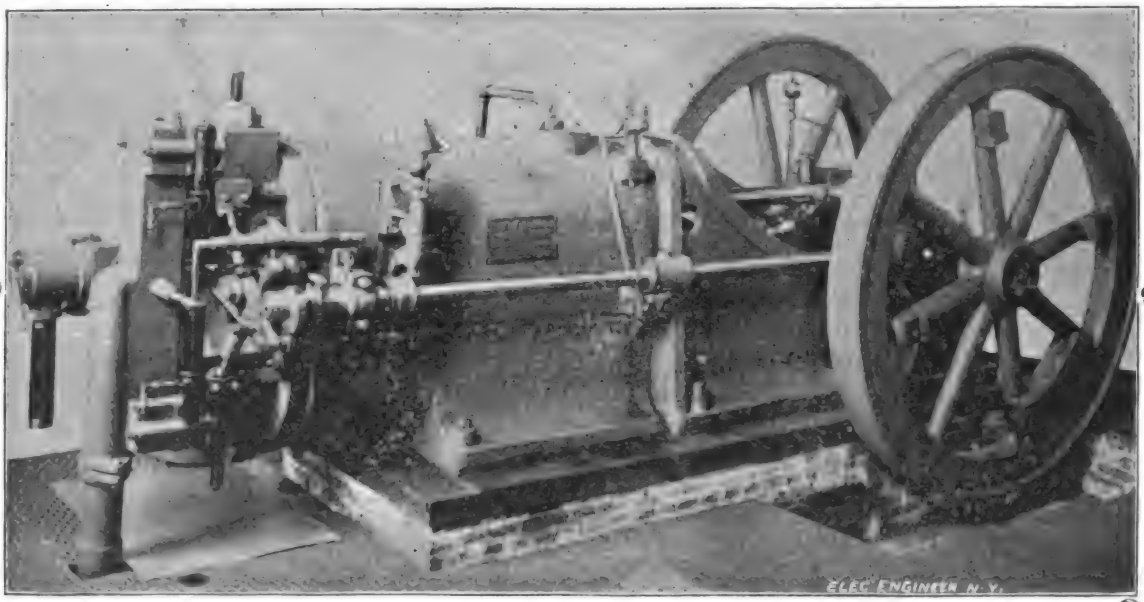
AND MECHANICAL DEPARTMENT

OTTO GAS ENGINES IN ELECTRIC LIGHTING.

It has long since been acknowledged, and proven over and over again by theoretical calculations, that no method of power production can reach as high an economy in the utilization of the heat units combined in the fuel as is obtained in the gas engine. This fact has spurred on the makers of gas engines to build larger sizes of engines every year and while the high prices for gas charged to the public restricts the size of engines used by it to those of less than 20 h. p., the gas companies themselves, consuming the gas as it is made on their own premises without charging it with the expenses of distribution, have had occasion to try practically the theories advanced for gas power; and as many of them operate electric light stations, it is in these that the gas engines were placed, varying in size from 50 to 100 h. p.

As it is the economy of the power in electric stations that makes the dividends, this departure with the gas companies, who are familiar with gas matters and would incline to the use of gas power more naturally than any other power users, was not only a happy one as far as they themselves were concerned, but it led others to make use of simple methods of gas production and utilize them in connection with gas engines.

At the Otto Gas Engine Works, in Philadelphia, we saw recently three engines of 100 h. p. each—for one order and intended to be used in conjunction with a producer gas system, which is to bring the coal consumption down to less than 1¼ pounds per horse-power per hour. This result has perhaps never before been arrived at, even by the best and most modern compound steam-engines. We understand that the English makers of gas engines have supplied gas producers in conjunction with engines to produce as high as 500 h. p., and that numerous power users requiring as low down as 30 h. p. find it economical to avail themselves of gas producers.



New 100 Horse Power Otto Gas Engine.

At the Philadelphia Otto Gas Engine Works a producer plant for 750 h. p. is now in course of erection for their own use as well as for experimental purposes and it will interest our readers to know that this method, as far as its use in this country is concerned, is used for electric light stations only.

Among the gas companies using gas power, we may mention the following:—Racine, Wis., Gas Light Co., 90 h. p., running 80 arc lights; Woonsocket, R. I., Gas Light Co., 100 h. p. arc and alternating incandescent; Oshkosh, Wis., Gas Co., 100 h. p., in course of erection; besides companies in Rockville, Conn., Grand Forks, N. D., Sioux City, Iowa, Atlantic City, N. J., Hamilton, O., and numerous other places. Quite a number of engines have been installed in isolated plants such as that of Potter Palmer, Chicago, C. F. Brush, Cleveland, Ed. Weston, Newark, N. J., the Electric Car Co., of America, Philadelphia, etc.

The Rockville Gas Co. has recently added to its 80 h. p., another engine, indicating a maximum of 120 h. p., which is illustrated in the accompanying engraving and which is the largest built up to the present time by any manufacturer, here or abroad. It is arranged with two cylinders, placed one above the other, and a gear shaft running near a centre line between the two gives motion to the various devices for admission of gas and air, ignition of same and exhausting of burnt gases. The ignition is effected by incandescent tubes, instead of by slides and flames.

At Rockville, the gas made is that known as water gas, made from anthracite coal and some oil is added to give illuminating power. Reducing the value of the oil to pounds of coal, taking into account their relative cost, and comparing the yield of gas of these materials with the cubic feet consumed by the engines it is found that less than two pounds of coal are consumed in Rockville for each horse-power hour.

RECENT WESTINGHOUSE WORK.

The month of December promises to bring such a great amount of new business to the Westinghouse Electric Company, that it will probably receive the credit of being the "Red Letter Month" of the year. A large number of the older alternating current central station plants have made contracts with the company for an increase in their capacities and among the new plants is one to be established at Kirkville, Mo., and another at Taylor, Tex. Each of these plants will have a capacity of 750 A. C. 16 c. p. incandescent lamps to start with, but it is expected that this will have to be increased very shortly.

Including these two new stations, the Westinghouse alternating current system is now operated in more than 350 central station plants. The total capacity of these stations aggregates 700,000 lamps. This is understood to be the greatest record of any electric manufacturing company in the world.

The street railway business of the Westinghouse Electric and Manufacturing Company is increasing in the manner which manifested itself from the very first day the company commenced to take orders for the equipment of electric street cars. The department is occupied day and night to its full capacity and the motors are now expected to be turned out as rapidly as they are demanded. Springfield, Ill., is the latest road in operation with the Westinghouse electric motor system and everything started off with the greatest success.

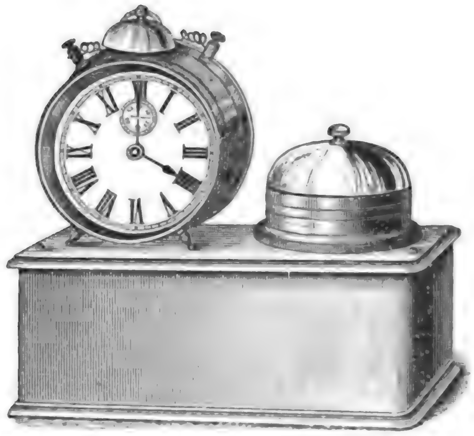
INSTALLATIONS OF THE EVANS FRICTION CONE SYSTEM.

The Evans Friction Cone Co., of 85 Water street, Boston, have received contracts for their friction system for the following plants: Lebanon (N. H.) Electric Light and Power Co., one 650 light alternator; W. S. Griffith & Co., Philadelphia, Pa., two 200 light Mather dynamos; Washington (Pa.) Electric Light Co., one 500 light alternator; Hopedale (Mass.) Electric Car Co., two 30 h. p. generators; National Transit Co., Oil City, Pa., one 140 light dynamo; Rhodes M'f'g Co., Philadelphia, Pa., two 80 light dynamos; A. M. Church & Co., Troy, N. Y., one 20 arc light and one 50 light incandescent; Clinton (Mass.) Gas Light Co., two 45 arc light, two 650 light alternators and one 30 h. p. generator; Worcester (Mass.) Polytechnic Institute, one 500 light alternator and one 250 light incandescent; Edison General Electric Co., Broad street, New York, one 180 light dynamo; Belfast (Me.) Electric Light Co., one 500 light alternator and one 300 light alternator; P. H. Glatfelter, Spring Forge, Pa., one 400 light incandescent and one 20 full arc; Seamless Rubber Co., New Haven, one 100 light dynamo; making a total up to date of 4,000 h. p. equipped.

THE "MANHATTAN" ALARM CLOCK.

The uses to which electricity can be applied in the home are becoming more and more manifold each day.

Clocks with attachments for bringing an electric circuit into action are not new, but their application has been in connection with more or less elaborate apparatus, chiefly burglar alarm work, where they are used to connect and disconnect the battery at cer-



THE MANHATTAN ALARM CLOCK.

tain hours. The accompanying cut shows an ingenious combination of a clock with circuit-closing mechanism, battery and bell. It is intended to take the place of the old-fashioned mechanical alarm clock which, with its few seconds ring, is the best that has been done up to this time. The great difficulty with this old clock is the short duration of the alarm, and here is where electricity steps in. The "Manhattan" clock is set in the usual manner to ring at a certain hour, and the movement of the clock throws into circuit a vibrating bell which will ring for about two hours, unless switched off. The cut shows binding posts on the top of the clock; but the legs of the clock may also serve as this feature, which allows the clock to be detached and used as an ordinary timepiece. Small receptacles are placed on the top of the box, to which are connected the wires to the bell and battery, and when the legs of the clock are set into these receptacles they serve as binding posts, being insulated from the metal body. The whole arrangement is handsomely mounted, the box containing the battery being made of hard wood, polished. The Manhattan Electric Supply Co., 36 Cortlandt street, this city, are the manufacturers of this useful novelty.

F. SARGENT, M. E. AND E. E.

Mr. F. Sargent has recently established himself at 215 Dearborn street, Chicago, as a consulting electrical engineer, having long recognized the fact that there existed a field for experienced engineers well posted in modern appliances and approved methods of construction, who were in a position to give unbiased advice to the investor. Mr. Sargent entered in 1875 the service of John Elder & Co., the famous Clyde engineers, who by the way, were the first to introduce both the compound and the triple expansion engines. He spent seven years in their shops and drawing offices, and took an active part in the designing and constructing of compound engines ranging from 500 to 15,000 h. p. indicated; as well as heavy gearing and mill work. The next four years were spent with prominent American firms designing steam, mill and mining machinery. He then became connected with the Edison Company, spending five years down to date, as chief engineer of the Western Edison Co.; superintendent, Chicago Edison Co.; chief engineer, Edison United Mfg. Co., and assistant engineer-in-chief, Edison General Electric Co.

Mr. Sargent does not intend going into construction work, but simply furnishes the necessary data and supervision for the complete installation of plants.

EUREKA TEMPERED COPPER ON ENGINES.

The following communication was recently addressed to the Eureka Tempered Copper Co., of North East, Pa., by the Pittsburgh Traction Co., E. W. Davis, superintendent:—"I have great pleasure in being able to testify to the excellent quality of your tempered copper. We have been using a guide shoe made of it on a 500 horse-power Corliss engine for the past six months; it looks as well to-day as when we put it on. We are also using your metal for connecting rod boxes on a 35 horse-power Ball engine, making 300 revolutions per minute. We find it takes much less oil than any other metal we have used, and runs much cooler. We intend equipping all our engines with your tempered copper."

THOMSON-HOUSTON PLANTS.

The Western Isolated Lighting Department of the Thomson-Houston Electric Company have closed contracts with the East St. Louis Packing and Provision Company, East St. Louis, Ill., for 800 incandescent lights;

Montgomery, Ward & Co., 111 Michigan avenue, Chicago, for 400 incandescent lights;

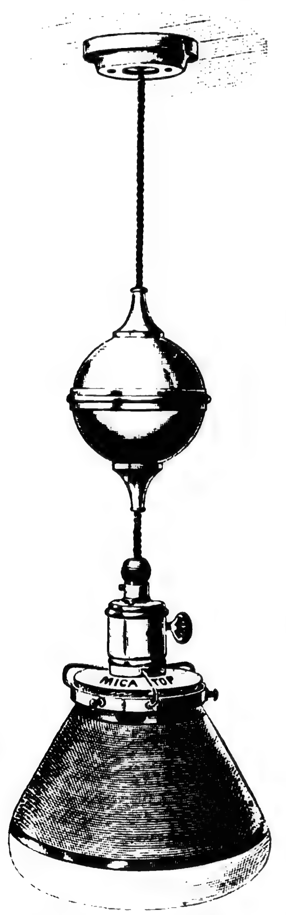
The Missouri Car and Foundry Co., of St. Louis, Mo., have bought of the Thomson-Houston Electric Co. through their St. Louis agent, the arc light dynamo exhibited during the recent exposition.

PASS & SEYMOUR'S CHINA SPECIALTIES.

Pass & Seymour, manufacturers of china for electrical purposes, at Syracuse, N. Y., have succeeded in making a china for electrical purposes that, they believe, far exceeds in strength any china heretofore made for the trade. Some of their customers are riveting brass work directly to their china pieces, and volunteer the statement that there is less than 1 per cent. loss of the china pieces in so doing.

THE BRADNER ADJUSTABLE HANGER FOR INCANDESCENT LAMPS.

WE illustrate herewith an excellent novelty, the Bradner adjustable hanger for incandescent lamps, which has just been put on the market in the East by the McCreary Electrical Specialty Co., of 18 and 20 Cortlandt street, and in the West by the Electrical Supply Co., of Chicago. This device consists of a suspended differential pulley enclosed in a neat brass shell. The flexible cord is wound several times around the large drum, passed through an opening and around the small drum; the lamp and shade being perfectly balanced by the weight of the pulley, the lamp will remain in any position between ceiling and floor. Should the lamp and fixture be heavier than the pulley alone there are small weights provided with each pulley, that fit a recess in the large end of the pulley, and by inserting one or more of these weights the balance can easily be made perfect.



Size A is especially adapted for all single light pendants in offices, stores, libraries, etc. Size B is for engravers, printers, factory and mill lights, the pulley being held in a stout wire cage. Size C is extra heavy for chandeliers, umbrella and cluster lights of all kinds.

Mr. C. C. Foster, the secretary of the company, has just returned from a six weeks' trip through the West. He reports business as excellent and has received larger orders than ever before.

THE WAY TO SPELL ALUMINUM.

We are pleased to note that that admirable electrical journal, THE ELECTRICAL ENGINEER, has joined the great majority of American technical journals and technical men in styling the latest addition to the list of cheap and useful metals alumin*um*, and not alumin*ium*, which latter designation it had previously been using, and which latter is still, we regret to say, the more common form in England. That a change will come soon there also, we cannot doubt. Reason, analogy, euphony, the history of the metal, the practice of all the large manufacturers, the genius of the language, which strongly leans toward the shortest form for all words in common use, all favor the shorter term. Unfortunately, chemists, naturalists and such like folk have rather a leaning the other way, toward using the longer form of any name when there is a choice, as seeming the more scientific and abstruse. While the metal was a mere chemist's curiosity, they had their way unchecked, and so managed to interpolate another syllable into a word used only by themselves. Now that it is coming into common use, it is becoming already clear that this unwarranted interpolation will not "stay put."—*Engineering News.*

THE BECKER VERTICAL MILLING MACHINE.

THE development of the electrical arts has created a demand for a machine which should be adapted for use on medium light work, and this has been successfully met by the machine illustrated in the accompanying engraving. In this machine, known as the No. 2 Becker Vertical Miller, there is employed an entirely new principle of the application of motion to the cutter spindle, by which means the friction of all belt strain, common to all ordinary milling machines, is done away with, utilizing the power thus gained, on the cut. With the cutter spindle and bearing entirely relieved from the usual strain of the belt, the spindle can be successfully run 10,000 revolutions per minute without any heating of bearings, or danger to cutter. This machine at 8,000 rev. per minute will carry a cutter ⅛" in dia., ¼" deep in brass or composition ten running inches per minute. For large cutters the speeds range from 240 to 1,400 rev. per minute; smaller mills from 2,400 to 10,000 rev. The counter-shaft has two sets of driving pulleys for two ranges of speeds. For surface milling with a 2" end mill it is on a large variety of small work superior to the planer both in speed and quality of work.

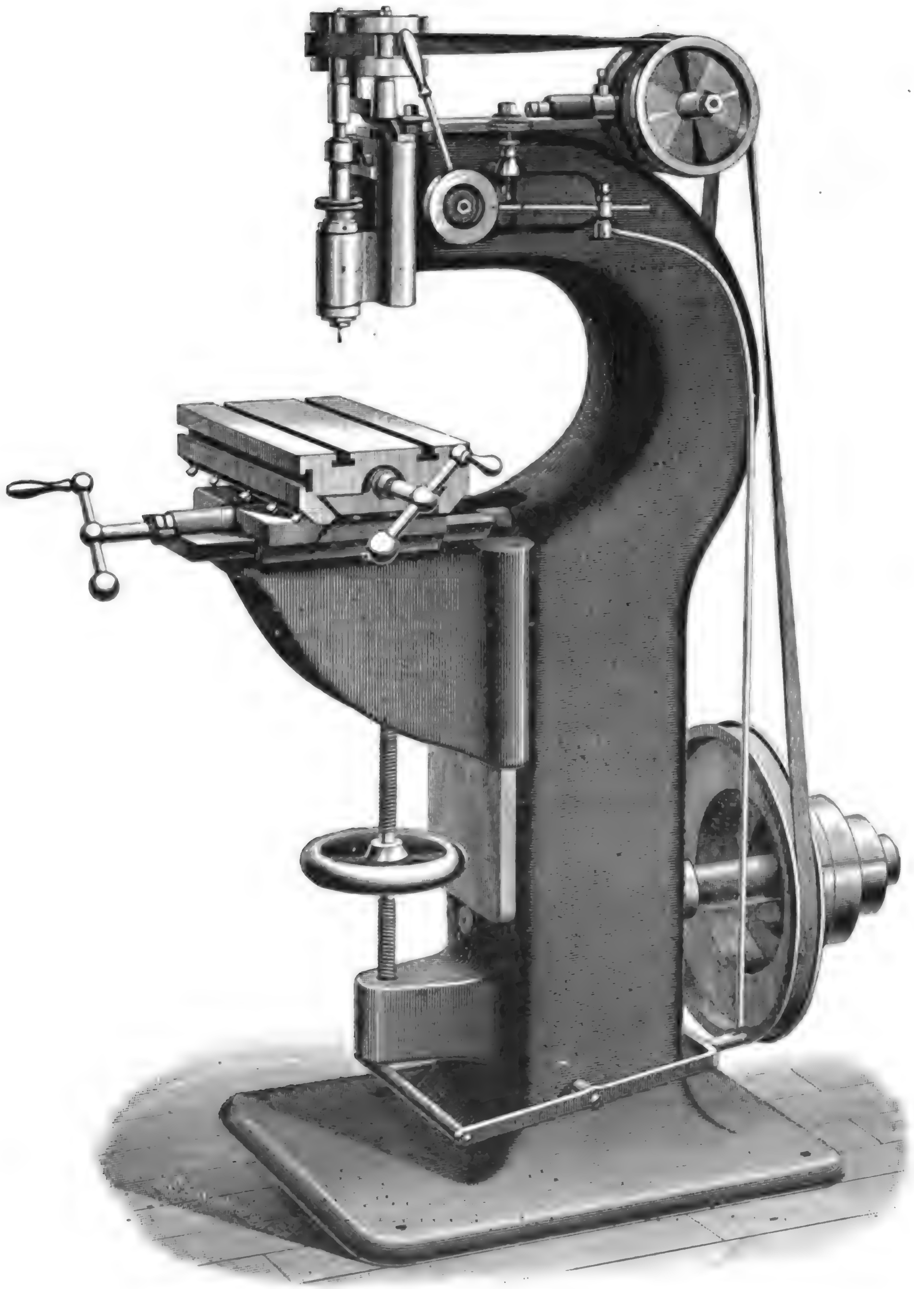
The No. 2 is specially recommended for use in machine shops where experimental electrical work is made a specialty. It is also specially adapted for metal engraving, as it will carry delicate cutters at the rate of over 10,000 revolutions per minute.

The hollow spindle is made of tool steel hardened and ground inside and out, running in aluminum bronze bearings.

The No. 1 machine is intended for the most delicate kind of metal engraving, being like No. 2 in all respects, except in size and weight.

The No. 3 miller is designed for heavy milling. It has hollow spindle with taper socket for Browne and Sharpe end mills, power feed, and rotary chuck with power feed for milling arcs, segments, etc.

These machines are built by the John Becker M'f'g Co., of 157 Pearl street, Boston, Mass.



THE BECKER VERTICAL MILLER.

A GLASS TELEPHONE SWITCHBOARD.

A plan to effect a saving of labor has recently been discussed in the New York telephone office. It is the project of a Chicago man, who proposes to make switchboards entirely of glass plates or sections, each containing 100 plug sockets. The board will be arranged horizontally. Each hole will be partially filled with mercury, which will afford a dust-proof contact. By this arrangement it is claimed that 24,000 metallic circuits may be handled on a section measuring 3 by 5 feet. The lines will be disposed in banks of 100 each, and a set of 100 line terminals will be contained in one glass plate 3 by 3 inches, including a space for numbers. No annunciators are to be used, and the orders will be taken directly by the operator without any preliminary signal. In other words, her ear will be always on the telephone line.

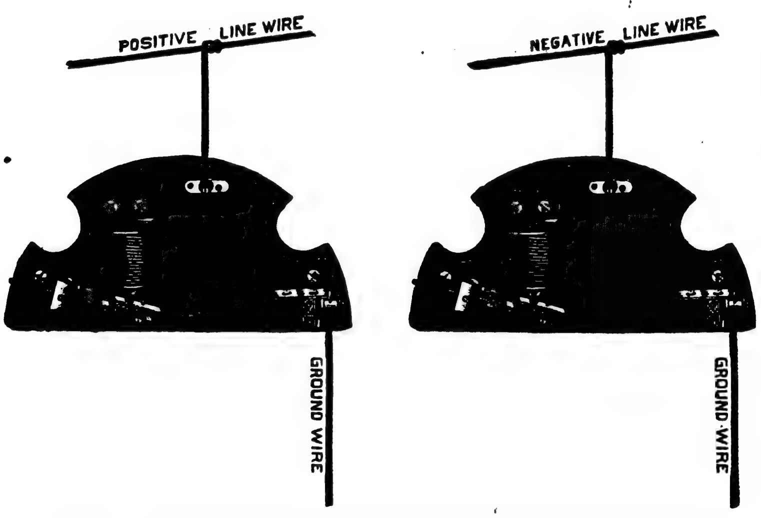
STANLEY AND HALL.

This well known and enterprising firm of electrical manufacturers, 32 and 34 Frankfort street, have recently brought out a number of novelties, one of which is their new combination armature rod and hammer to be used in connection with their popular dust proof bell, to which it forms a neat and effective complement, meeting the objections to the old style of rod in general use.

Stanley & Hall have lately prepared and distributed among their friends and customers a very handy and pretty nickel plated screw driver, all metal from handle butt to business end. They have also got out, in the same philanthropic spirit, a useful little 6 inch pocket rule of celluloid ivory, made to fold, and divided off in eighths of an inch.

THE SPERRY CO'S. NEW LIGHTNING ARRESTER.

We illustrate on this page the new lightning arrester recently brought out by the Sperry Electric Co., of Chicago. The cuts, Figs. 1 and 2, show the method of operation clearly. The appliance is shipped by the company, with all their plants, and is very effective, owing to the fact that while it clears the lines thoroughly of invasive static charges it is free from liability to short circuit the dynamo on itself. It is said that through its automatic action and instantaneous recovery it answers its purpose to admiration, having been known to dispose of more than a



Figs. 1 and 2.—The Sperry Co.'s New Lightning Arrester.

dozen lightning discharges in a single storm. The arrester is carefully mounted on a neat wooden base as shown, and the exposed metallic portions are nickel plated. The company invite correspondence as to this meritorious device.

PHILADELPHIA TRADE NOTES.

Warren Webster & Co.—The "Vacuum" Exhaust Steam Economizers manufactured by the above named company, are enjoying a brisk demand and are day by day becoming more appreciated by central station men who are anxious to save on the coal end of the line (and most of them are). The recommendation we print below is a fair sample of many letters received by Mr. Webster containing spontaneous expressions of enthusiastic gratification with the performance of the "economizer." We omit the name of the heater whose performance was not so satisfactory as the Webster's:

American Tube and Iron Co.,
Middletown, Pa., Oct. 10, 1890.

Messrs. Warren Webster & Co., Philadelphia, Pa.

Gentlemen: After having made a trial during the past two months of your 500 horse power "Vacuum" Exhaust Steam Economizer at our Youngstown mills, we found it to give an average of 10 degrees higher temperature of feed water than the temperature gotten from the 500 horse power ———. The conditions during the tests were the same; and we accept it, as it fulfilled your guarantee.

Please hurry delivery of the one we ordered for the machine shop boilers, and oblige. Yours truly, etc.

The new catalogue of Warren Webster & Co. will be found interesting to central station men, and will be promptly mailed upon application.

WESTERN TRADE NOTES.

The Fort Wayne Electric Co. have recently made an increase of 500 lights to the Litchfield mine plant. Mr. W. J. Buckley has just closed contracts for 120 Wood arc lights and 650 incandescents of the Slattery induction system with Armour & Co., Kansas City, Mo. Mr. J. E. Keelyn has sold Montgomery Ward & Co. 50 Wood arc lights and 400 incandescent lights. This company have just put upon the market a new dynamo of 80 2,000 c. p. lamps capacity. The machine is of the well-known Wood pattern, and, it is said, the largest size of arc dynamo that has ever been made commercially practicable. Among other recent sales are two plants sold to Philadelphia, one of 360 arc lights, Wood system, and the other comprising five 1,000 and one 650 Slattery alternating incandescent machines. The Fort Wayne Electric Co. are making arrangements for equipping the West End line at Ft. Wayne, Ind., with the Slattery system of storage battery cars. The Municipal Electric Light and Power Co., of St. Louis, Mo., have ordered an addition of 300 arc lights of 2,000 c. p. from the Ft. Wayne Electric Co., making a total of 3,675 2,000 c. p. arc lamps sold by the Ft. Wayne Co. to St. Louis and now burning on the streets there.

The Matchless Metal Polish Co., No. 88 Market street. Chicago, recently received through the Department of State at Washington the bronze medal and certificate of award for the best metal polish exhibited at the Centennial International Exhibition held at Melbourne in 1888. On the obverse is a likeness of Queen Victoria, and on the reverse side is a wreath composed of the British oak and the Australian wattle. The two ends of the wreath are bound together at the stem by a true lovers' knot. In the centre is the motto, "Artibus Dignis Honor Insignis," and the five stars of the Southern cross. The distinction was won in competition with metal polishes from France, Germany, England and other countries.

Mr. J. R. Markle, of the Markle Engineering Co., of Detroit, Mich., accompanied by Mr. Thomas P. Whittier, was a caller at this office last week. They are busily engaged in working out a number of new and valuable specialties for electrical work.

Mr. W. S. Love, secretary of the Pond Engineering Co., of St. Louis, has been in town for some days visiting their Chicago office. Mr. Albert Blanchard, the well-known Chicago representative of the company, has been so loaded down with filling orders and looking after construction work that Mr. Love's assistance has been very welcome to him.

The Thwing Electric Co. are busily engaged in fitting up their new factory at the corner of Lake and Peoria streets. This company will manufacture incandescent lamps and various other electrical specialties.

The Nubian Iron Enamel Co., W. Jackson street, Chicago, are doing a very large business in their iron enamel paint and other specialties. Their enamel is especially suited to electrical work, such as coating arc lamps, dynamos, etc.

NEW ENGLAND TRADE NOTES.

The Standard Electric Company, of Vermont, have sold a 500 light standard dynamo to the Overman Wheel Company, at Chicopee Falls, Mass.

Mr. D. C. Spruance, of the Star Electrix Company, of Philadelphia, was in Boston this week looking up business in the interests of his company. Mr. Spruance has had a wide and thorough experience in electrical work in various fields and different capacities, and knows well what to offer to the electrical trade in the way of interesting novelties. They are at present pushing the Star switch and electric attachments for gas brackets, which are having a large sale. Mr. Spruance is associated in his new enterprise with Mr. Norman Marshall, who is well known in New England, and who has also had a wide training in electric light business. With such a combination and good goods to offer, success is assured.

The Economic Electric and Manufacturing Company, at Brockton, threw their factory open to the inspection of the Brockton Commercial Club this week, and showed the members the mysteries of the manufacture of incandescent lamps. Business has been steadily growing with this company, and they now have a brisk demand for their goods. At present they are stretching every nerve to increase their plant, and are daily adding to their capacity, installing pumps as fast as they can be built. The lamps have now been well tested, and have given remarkable results, both for efficiency and lasting qualities.

ST. LOUIS TRADE NOTES.

The Southwestern Electrical Engineering Co. have taken quarters with the St. Louis Electrical Supply Co., at No. 403 N. Eighth street, where they will continue their usual line of work in electrical engineering and construction work.

Van Nort Bros. have taken quarters at 515 Walnut street and will carry on a general business of electrical engineering and construction work.

THE
Electrical Engineer.

VOL. X. NOVEMBER 19, 1890. No. 133.

A PRACTICAL GUIDE TO THE TESTING OF INSULATED WIRES AND CABLES.—I.

[*Copyright, The Electrical Engineer.*]

BY HERBERT LAWS WEBB.

THE use of high-class insulated wires, both in the form of underground and overhead cables, and, indeed, for all classes of electrical work, has of late years increased to such an extent in this country that the necessity for careful and systematic testing has grown proportionately, and an opinion exists, shared both by the editors of THE ELECTRICAL ENGINEER and the writer, that a simple and practical description of the methods and apparatus employed in making tests for insulation resistance, inductive capacity and conductor resistance, would probably be welcome to those who find it necessary to include such work in the catalogue of their daily duties.

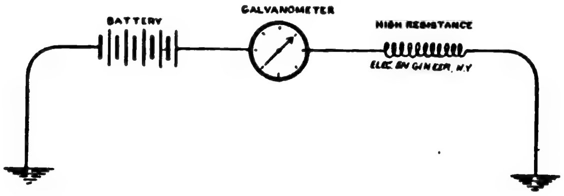


FIG. 1.

It is not a difficult matter for anyone who exercises a little ordinary care to make the usual tests referred to if the instruments are properly set up for him and nothing goes wrong; but it is not unusual to find a man take very kindly to working in this way and yet not have more than a very vague idea of what he is actually doing, and why certain manipulations of the battery and keys give certain results and certain other manipulations give quite distinct results. For this and other reasons, in preparing these articles I have decided to confine myself strictly to the most simple methods (which, be it stated, are those most generally used), and to describe them very fully, avoiding mathematics as far as possible. If after following me through these first courses in the science of electrical testing, any budding expert has acquired an appetite for stronger meat and more of it (as I sincerely hope he will) let him turn to Kempe, where he will find it in abundance.

A wire or cable to be used for telegraphic or telephonic purposes is submitted to three distinct tests, in order to determine its insulation or dielectric resistance, inductive or electrostatic capacity, and conductor resistance. The conditions of the wire are generally referred to as insulation, capacity and resistance, and the greatest of these three is insulation.

When we test a wire for insulation or dielectric resistance, we simply measure the resistance offered by the insulating covering to the passage of a current of electricity from the conductor to the ground. This is done by charging the wire from a powerful battery, the distant end of the wire being free, or disconnected, and the current being allowed to pass through a delicate galvanometer before entering the wire or cable. Now, it is clear that as the far end of the wire is not connected to anything, the only escape for the current is across the insulation to ground. A certain amount of current escapes in this way, causing a deflection of the galvanometer needle. By comparing this deflection with that obtained by allowing the current to flow to ground through a known resistance we arrive at the resistance of the insulation.

It stands to reason that the first operation is to obtain this standard deflection with which the deflection given by the cable is to be compared; this is called "taking the constant of the galvanometer," and the deflection obtained is generally termed the *constant.*

Fig. 1 shows diagrammatically the arrangement of instruments for getting the constant. One pole of the battery is connected to earth, and the other to one terminal of the galvanometer, the second terminal of which is joined to one side of the high resistance, the other side of the high resistance going to earth.

Here we have a complete circuit through the galvanometer coils and high resistance, and the galvanometer needle is deflected over a certain number of divisions of the scale, and remains steady at that point, as long as no variation takes place either in the strength of the battery or in the amount of resistance in circuit. In this way we know how much the galvanometer needle will be deflected when a certain resistance is offered to the current from the battery. The deflection is noted and constitutes the galvanometer constant. By comparing the deflection obtained from the cable with this deflection, the insulation resistance of the cable, in terms of the resistance used in taking the constant, is arrived at. In practice, as we shall see further on, the galvanometer is always shunted when taking the constant, so that only a fractional part of the current shall pass through the galvanometer coils, but for the sake of clearness the shunt is not shown in the diagram.

In Fig. 2 the cable is substituted for the high resistance shown in Fig. 1. The cable is charged up from one end

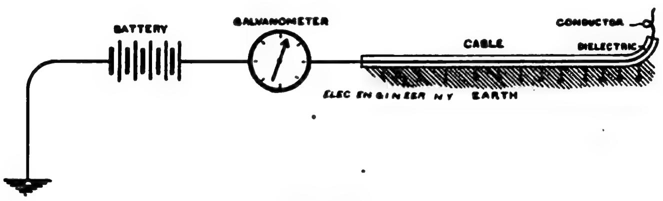


FIG. 2.

by the battery, the far end being free, and the current passes to earth across the dielectric, much in the same way as it would through the coils of the high resistance. A slight leakage of current takes place along the whole length of the cable, and the longer the cable the more leakage there will be. The passage of the current through the insulation to ground will be more readily understood if the dielectric be considered, as it really is, merely a conductor of very high resistance, one side being in close contact with the earth and the other side connected by the cable conductor, which, of course, makes perfect contact with the dielectric along its whole length. In this case the dielectric merely takes the place of the high resistance, the conductor of the cable being the connecting wire. It is plain, therefore, that the leakage will vary directly as the length of the cable, which constitutes the cross-section of the conductor whose resistance we are measuring; the longer the cable, the greater the cross-

section of the conductor and the lower its resistance; while, if the cable is short, the cross-section of this high resistance conductor will be correspondingly decreased, causing a proportionate increase of resistance. The length, of course, is always the same, being merely the thickness of the dielectric.

The simplest method of measuring the electrostatic

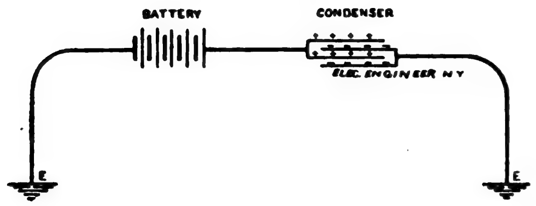


FIG. 3.

capacity of an insulated wire or cable is by comparing the charge of electricity which it is capable of receiving, with the charge of a standard condenser of known capacity. A condenser is practically a Leyden jar in a small space, and consists of a number of plates of tinfoil alternated with plates of mica or paraffined paper. On connecting one pole of a battery to one set of the tinfoil sheets, the other pole of the battery and the other set of tinfoil sheets being connected to earth, the condenser is charged to its full capacity, the charge on one set of plates inducing another of opposite sign on the other set of plates. This arrangement is shown diagrammatically in Fig. 3.

If now we connect the terminal of the condenser, which

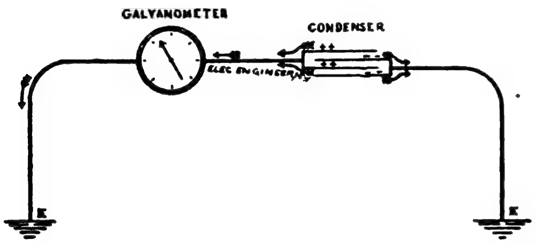


FIG. 4.

was first connected to the battery, to earth through a galvanometer, as in Fig. 4, the charge is released, and a discharge to earth takes place, producing a sudden throw of the galvanometer needle. This deflection is noted. The discharge from the cable can now be obtained in the same manner. The cable itself is practically a condenser, the conducting wire being one plate, the outer sheathing the other, and the dielectric the separating medium. If, as in Fig .5, we connect the battery to one end of the conductor, the far end being left free, the cable will be charged up in the same way as the condenser. After charging for a few seconds the battery is disconnected and the cable is allowed to discharge to earth through a galvanometer, as shown in

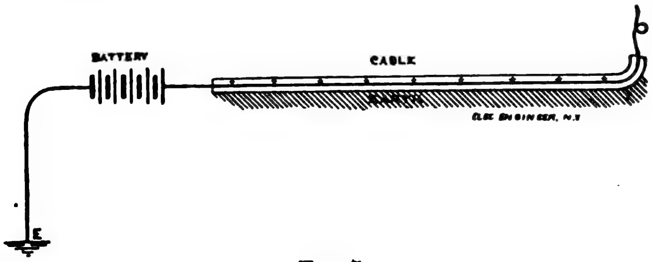


FIG. 5.

Fig. 6. The deflection produced is noted, and dividing it by the deflection obtained at the discharge of the standard condenser, we arrive at the capacity of the cable in terms of the capacity of the standard condenser.

In Fig. 7 is shown diagrammatically the method of measuring the resistance of a conductor, by means of the Wheatstone bridge. One pole of the battery is connected to the centre of the bridge at A, the other pole being put to earth. The conductor is connected to one end of the bridge at C; and to the other end, at B, is connected an adjustable resistance; both the conductor and the adjustable resistance being also connected to earth. Between B and C is placed the galvanometer. The current from the battery divides at A and goes to earth partly by way of A C and the cable, and partly by way of A B and the adjustable resistance. It is obvious that if the branches between A and the earth are not of equal resistance, there will be a difference of potential between B and C, and, there being a connecting path between them by way of the galvanometer, a certain amount of current will pass from one point to the other, producing a deflection on the galvanometer.

By consulting the diagram, the aptness of the term, bridge or balance, is easily noticeable. Assuming the

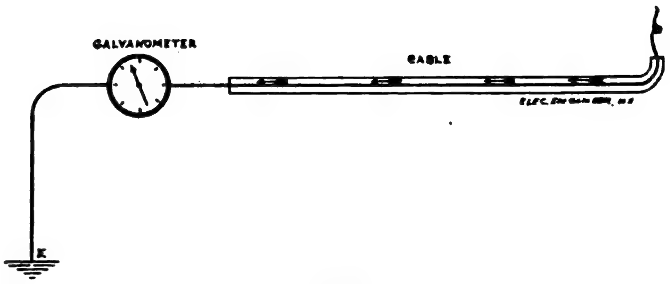


FIG. 6.

arm B A C to be the beam of a balance, and the galvanometer to be the pointer, it is obvious that the pointer will only be at zero, when the objects attached to B and C are exactly equal, assuming the two arms to be of equal value. If a deflection is produced on the galvanometer it is a sign that there is a difference of potential between B and C, and that consequently the resistance connected to B is not equal to that connected to C. As the latter is the fixed resistance to be measured, the adjustable resistance must be altered until there is no deflection on the galvanometer. This shows that the battery current dividing at A flows in equal proportions towards B and C, producing equal poten-

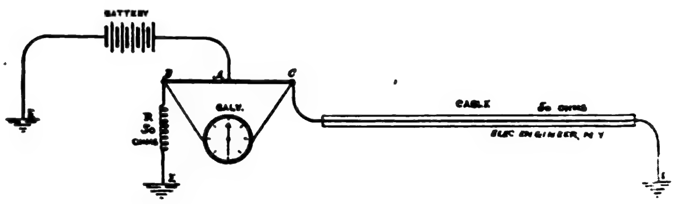


FIG. 7.

tials at those points; consequently, the resistances attached to B and C are now equal, and the resistance of the cable is ascertained by observing the amount of resistance in the adjustable coils.

CHICAGO AND THE BRAGG FIRE ALARM HITCHING PATENT.

"The Indianapolis electricians are doomed to be disappointed if they expect to get $100,000 royalty on the Bragg patent from Chicago," says Electrician Barrett.

In an Indianapolis dispatch it is claimed that under a recent decision of the Supreme court in favor of the owners of the Bragg patent for releasing the horses and dropping the harness upon them simultaneously with the sounding of the fire alarm royalty to the extent of $100,000 can be collected from Chicago, St. Louis, and other cities now using this system in their fire departments. "Chicago," says Mr. Barrett, "has not used the system since it was patented. Three years before the patent was secured we used the plan, but discarded it because it was not suited to our purposes. We now use our own system."

THE LA ROCHE SYSTEM AT DEVON, PA.

The incandescent light, which had until within recently been confined mainly to the larger cities, is rapidly making headway in the smaller towns, and even to-day we see the installation of incandescent plants in towns where it would have been considered absurd to enter upon the commercial distribution of electric light but a short while ago. As an instance of this we note the recent starting at Devon, Chester Co., Pa., of a station operated by the Devon Electric Light and Power Co.

The entire electrical plant was built and equipped by the La Roche Electric Works, of Philadelphia, and for that purpose there were installed two 400 light La Roche dynamos (of the type familiar in a large number of isolated plants), one 80 h. p., Beck high speed engine, and a 100 h. p. boiler. The system of line construction adopted embodies quite a number of novel methods and a potential of 110 volts is carried on the entire system.

La Roche Central Station Plant, Devon, Pa.

Great care has been taken to maintain the potential equal in every part of the circuit, and at no point does the drop exceed 2 per cent. The success already obtained with the plant is such that it will be increased to double its capacity during the coming winter. The accompanying engraving, made from a photograph, is the first ever made of a La Roche central station plant, and shows the plant installed, which has worked without interruption since its inauguration.

A LABORATORY ON WHEELS.

One of the electric lighting companies in Paris has introduced a traveling testing-room or ambulance laboratory for use when repairing cables. The van is fitted with a battery and testing instruments, including a photometer, and is large enough to hold two persons. The plant has been in use since April last, and is found to work well.

THE GEYER-BRISTOL INTEGRATING METER FOR CONTINUOUS OR ALTERNATING CURRENTS.

As originally designed and described before the American Institute of Electrical Engineers,[1] the Geyer-Bristol meter was a self-registering instrument, which made a continuous record in ink on a uniformly moving chart. For commercial use, however, an integrating type of meter is most desirable, and it was with a view of meeting this need that the form described below has been designed. The Geyer-Bristol differential expansion-bar is used, which consists of two elements of the same metal, bound together, but insulated from each other except at one end. The elements are of such relative cross section that one is heated to a greater degree by the passage of the current, than the other. The resulting deflection due to the difference in expansion of the elements gives an indication of the amount of current. In the application of the bar for a self-registering meter a pen is attached directly to the free end of the bar and records the amount of deflection on a uniformly revolving dial.

In the integrating form of the meter the differential expansion-bar is combined with a drum provided with tappets which are adapted to engage with an arm or extension carrier at the free end of the bar itself. The vibrations of the arm are directly transmitted to a register or counter by means of a ratchet wheel. Figs. 1 and 2 (page 556) represent respectively a side and an end view of the present device. At the lower free end of the expansion-bar an arm or extension is attached by a spring-plate *a*, the arm or extension being in the plane of motion of the bar, and in virtue of its spring connection with the bar it is capable of being moved or vibrated at right angles to the plane of deflection of the bar without appreciably moving the bar from the position it would naturally take, due to the current. The drum E, is uniformly rotated in the direction of arrow 2, Fig. 2, by a motor or clock movement. The surface of the drum and

1. The Electrical Engineer, December, 1888.

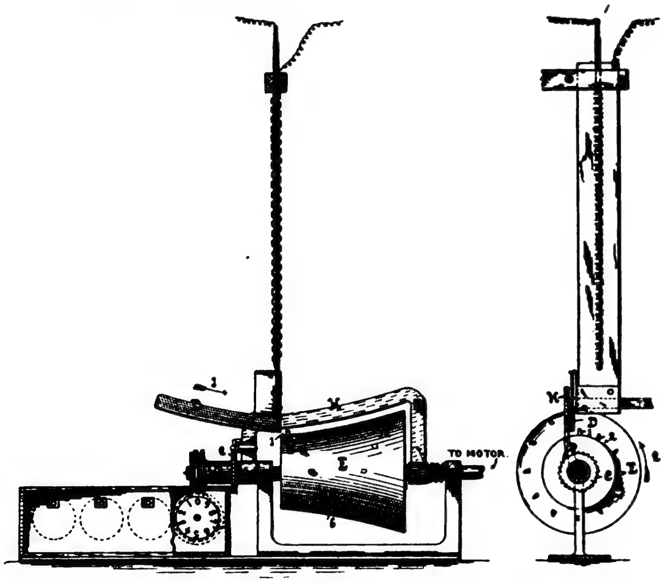
the lower edge of the extension D are of such form that the motion of the extension arm across the drum will be approximately parallel to the surface of the drum.

The tappets shown on the surface of the drum are arranged to engage with the arm or extension D and to vibrate or deflect the same. No two of the pins or tappets lie in the same longitudinal element of the drum; consequently the greater the deflection of the bar the more frequently the arm or extension is deflected or vibrated. At the rear of the extension D and parallel to it is located a frame having bearings in line with the axis of the drum. The lower edge of the frame is above the lower edge of the extension D, so that it is above the path of the pins or tappets on the drum.

It will be evident that when the extension D is vibrated by the tappets it impinges upon the swinging frame and imparts its motion to the frame. Upon the release of the extension arm, both the arm and the frame return to their normal positions. The swinging frame carries a pawl which engages with the ratchet wheel *e*, turning the wheel through one tooth at each vibration. The ratchet wheel could itself be one of a train of counters, or its motion may be transmitted to a system of counters by means of a worm-wheel, as shown.

The action of the instrument will now be readily understood. When no current is passing, the expansion-bar stands in the position shown in Fig. 1, and the tappets on the uniformly revolving drum pass successively under the swinging frame without touching it, and consequently without operating the counter. Under the influence of a current passing through the bar, it will deflect in the direction indicated by the arrow 1 and assume a position corresponding to the strength of the current. The extension arm D will thus be brought into the path of the tappets and will be vibrated more or less according to the deflection of the bar.

The tappets are situated along the length of the drum so that the spaces between them correspond to the amount of deflection per ampere of current; from which it will be seen that the reading of the counter will be the summation of the current in amperes.



FIGS. 1 AND 2.—THE GEYER-BRISTOL INTEGRATING METER.

Where it is desired to increase the range of the instrument, a compound meter is used, both bars of which ultimately actuate the same counter. Suitable devices are also provided to automatically cause the current to pass through one bar or the other, according to the strength at the time. Fig. 3 shows a diagram of the two bars, the circuits, the connections and devices used for automatically causing the current to pass through one bar or the other. In this diagram A B represents the more sensitive bar or galvanometer, and A′ B′ the less sensitive bar. I is the dynamo or other source of current which is to be measured. J is an electro-magnet, K its swinging armature, and L a device for placing the armature under tension and for regulating the tension. The current from the dynamo, when the parts are in the position shown in Fig. 3, is as follows: From the dynamo through the wire 12, the coils of electro-magnet J, elements

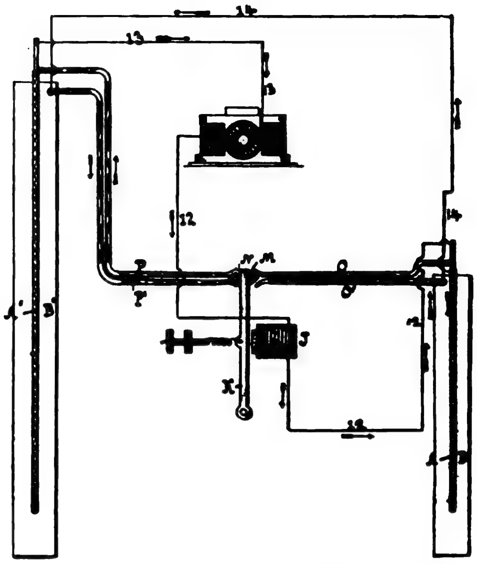


FIG. 3.—THE GEYER-BRISTOL INTEGRATING METER.

A and B of bar AB over wire 14 to element B′ of bar A′ B′ through the conductors P P′ and contact N, and over wire 13 to the dynamo; thus producing a deflection in the bar AB. The resistance offered by the elements A′ B′ to the current when compared with that of the conductors PP′ is so great that no appreciable current flows through that bar. Consequently it is not deflected, and the bar AB alone operates the integrating device as long as the current is maintained within the range that the bar has been designed for.

If now the strength of the current becomes such as to exceed the range of the bar AB, the armature K is attracted by the electro-magnet J. The circuit is broken at N through conductor PP′, and closed at M through conductors OO′. The current will then flow through the bar A′ B′, while the bar AB is not appreciably affected.

It will be noticed that the circuit is never broken, consequently sparking at the contacts M and N will not occur, so that the danger of burning the same is averted.

ELECTRICAL OSCILLATIONS.[1]

BY PROF. J. TROWBRIDGE.

THE author has photographed the oscillatory discharge of air condensers by means of a revolving mirror making 3000 revolutions per minute; and he also placed a Leyden jar within a coil charged by a Gramme machine to observe whether a powerful magnetic field affected the electric waves. The latter has not been found, but will be further investigated. As regards the first experiment, he concludes that the effective capacity of an air condenser depends upon the rapidity of its vibrations, *i. e.*, that its dielectric coefficient is not a constant. This Dr. Lodge—who has made similar experiments, as have also Boys and Bottomley—questions, as the capacity of the leads had been able to produce something like the observed anomaly, or hysteresis.

1. Abstract of a paper presented at the British Association Meeting, Leeds.

TABULATED CONSTANTS FOR DETERMINING THE HORSE-POWER OF TRACTION.

BY W. F. D. CRANE, M. E.

The table of constants forming a part of this article will be found especially convenient by those who have much to do with traction calculations, as by its use the operation of finding the horse-power by the ordinary formulas may be much abbreviated.

The usual formula

$$\frac{W \times S \times K}{33000} \quad \frac{W \times 2000 \times S \times \sin\theta}{33000} = \text{h. p.}$$

wherein W is the weight to be moved in tons; S, the speed in feet per minute; K, the coefficient of resistance to be overcome in pounds per ton; and θ, the angle of the grade. The formula consists of two parts: The first, involving K, relates to levels exclusively, and the second to the additional power required to raise W through the vertical distance represented by the sine of the angle of the grade to be ascended; the sum of the two, therefore, gives the total power required to move the weight W up an inclined plane. The double sign of plus and minus is introduced, for, in climbing a grade, the power required on a level is augmented by the work required to raise the weight through sin θ; while in descending the grade the potential energy of the weight may be in excess of the track and other resistances included in K, and the vehicle will descend of its own accord.

For these reasons the table of constants given herewith naturally divides itself into two parts, each part being computed from its respective part in the modified formula

$$\frac{Wn}{375}(K \pm 2000 \sin\theta) = \text{h. p.};$$

or,

$$Wn \times .002666\,(K \pm 2000 \sin\theta) = \text{h. p.},$$

in which the speed n has been converted into miles per hour from feet per minute. It is convenient to remember that a speed of 88 feet per minute is equivalent to a speed of one mile per hour. For instance, if a car travels 500 feet in 50 seconds, it will have traveled 600 feet in one minute, which, divided by 88, gives a speed of 6.8 miles per hour.

W, n, K, and sin θ (the latter conveniently represented in per cent., or so many feet rise per hundred) are therefore variable. Taking $K = 10$, for the sake of brevity, and substituting the miles per hour and per cents. of grade given in the table, we find therein the constants of power required to move one ton.

Let H represent the constants of power given in the table required to move one ton on a level at the speeds given with $K = 10$. Then

TABULATED CONSTANTS FOR DETERMINING THE HORSE POWER OF TRACTION.

COMPUTED BY W. F. D. CRANE, M. E.

H. P. $= \frac{Wn}{375}(K \pm 2000 \sin\theta)$. W = Load in tons. n = Speed in miles per hour.

$= Wn \times .0026\frac{2}{3}\,(K \pm 2000 \sin\theta)$. K = Resistance in pounds per ton. $K' = \frac{K}{10}$.

H = Constants of power required to move ONE TON on LEVEL at speeds in table, with $K = 10$.
H' = Constants of ADDITIONAL POWER required to raise ONE TON on GRADES and at speeds given.
$H \times WK'$ = H. P. required on LEVELS alone for speeds given.
$H' \times W$ = H. P. additional on GRADES alone for speeds and % given.
$W(K'H \pm H')$ = total H. P. required.

Miles per Hour.	H on Levels $K = 10$.	H′ on Grades—To be Added to Horse Power on Levels.												
		1%	1½%	2%	2½%	3%	3½%	4%	4½%	5%	6%	7%	8%	9%
¼	.00666	.01333	.0200	.0266	.0333	.0400	.0466	.0533	.0600	.0666	.0800	.0933	.1166	.1200
½	.01333	.0266	.0400	.0533	.0666	.0800	.0933	.1066	.1200	.1333	.1600	.1866	.2133	.2400
¾	.0200	.0400	.0600	.0800	.1000	.1200	.1400	.1600	.1800	.2000	.2400	.2800	.3200	.3600
1	.0266	.0533	.0800	.1066	.1333	.1600	.1866	.2133	.2400	.2666	.3200	.3733	.4266	.4800
1½	.0400	.0800	.1200	.1600	.2000	.2400	.2800	.3200	.3600	.4000	.4800	.5600	.6400	.7200
2	.0533	.1066	.1600	.2133	.2666	.3200	.3733	.4266	.4800	.5333	.6400	.7466	.8533	.9600
2½	.0666	.1333	.2000	.2666	.3333	.4000	.4666	.5333	.6000	.6666	.8000	.9333	1.066	1.200
3	.0800	.1600	.2400	.3200	.4000	.4800	.5600	.6400	.7200	.8000	.9600	1.120	1.280	1.440
3½	.0933	.1866	.2800	.3733	.4666	.5600	.6533	.7466	.8400	.9333	1.120	1.306	1.493	1.680
4	.1066	.2133	.3200	.4266	.5333	.6400	.7466	.8533	.9600	1.066	1.280	1.493	1.706	1.920
4½	.1200	.2400	.3600	.4800	.6000	.7200	.8400	.9600	1.080	1.200	1.440	1.680	1.920	2.160
5	.1333	.2666	.4000	.5333	.6666	.8000	.9333	1.066	1.200	1.333	1.600	1.866	2.133	2.400
5½	.1466	.2933	.4400	.5866	.7333	.8800	1.026	1.173	1.320	1.466	1.760	2.053	2.346	2.640
6	.1600	.3200	.4800	.6400	.8000	.9600	1.120	1.280	1.440	1.600	1.920	2.240	2.560	2.88
6½	.1733	.3466	.5200	.6933	.8666	1.040	1.213	1.386	1.560	1.733	2.080	2.426	2.773	3.120
7	.1866	.3733	.5600	.7466	.9333	1.120	1.3066	1.413	1.680	1.866	2.240	2.613	2.986	3.360
7½	.2000	.4000	.6000	.8000	1.000	1.200	1.400	1.600	1.800	2.000	2.400	2.800	3.200	3.600
8	.2133	.4266	.6400	.8533	1.066	1.280	1.493	1.706	1.920	2.133	2.560	2.986	3.413	3.840
8½	.2266	.4533	.6800	.9066	1.133	1.360	1.586	1.813	2.040	2.266	2.720	3.173	3.626	4.080
9	.2400	.4800	.7200	.9600	1.200	1.440	1.680	1.920	2.160	2.400	2.880	3.360	3.840	4.320
10	.2666	.5333	.8000	1.066	1.333	1.600	1.866	2.133	2.400	2.666	3.200	3.733	4.266	4.800
11	.2933	.5866	.8800	1.173	1.466	1.760	2.053	2.346	2.640	2.933	3.520	4.106	4.693	5.280
12	.3200	.6400	.9600	1.280	1.600	1.920	2.240	2.560	2.880	3.200	3.840	4.480	5.120	5.760
13	.3466	.6933	1.040	1.3866	1.733	2.080	2.426	2.773	3.120	3.466	4.160	4.853	6.346	6.240
14	.3733	.7466	1.120	1.493	1.866	2.240	2.663	2.986	3.360	3.733	4.480	5.226	5.973	6.72
15	.4000	.8000	1.200	1.600	2.000	2.400	2.800	3.200	3.600	4.000	4.800	5.600	6.400	7.200

$H \times WK' =$ h. p. required on levels alone.

$$K' = \frac{K}{10}$$

$$H' \times W = \text{h. p.}$$

will be the additional horse-power required on grades, the same to be added to, or subtracted from, the horse-power on the level to give the total horse-power required to drive the vehicle when moved up-hill and down-hill, respectively.

These two parts of the formula used singly in determining the horse-power required for each, and afterwards algebraically added to find the total power required, will usually be found to be the more useful and instructive form in which to use the general formula, which in this case reduces to

$$W(K' H \pm H') = \text{h. p. total.}$$

K has been found to vary in value from 12½ to 20 lbs. on clean raised rails, and from 20 to 56 lbs. on sunken rails. Perhaps 30 lbs. is a fair working average for tramways with the rails in good condition or wet. The influence which dirty tracks have upon the increased value of K and consequently upon the increased power necessary to move a self-propelled car has been frequently underestimated, and the safety of the motors imperilled in consequence of the over-duty required of them, and the success of a system insufficiently supplied with power has been delayed by inadequate allowances in the original calculations for increased traction and other resistances. However, much of the insufficiency of power in motor systems can be traced more directly to underestimated losses in the motors and power transmitting mechanism. But a sandy or dirty track covered with gravel or frozen mud is alike dreaded by the power station manager and storage battery enthusiast.

A few illustrations will show the application of the constants given in the table.

1. Assume an electric motor car weighing, with load, 8 tons, to pull a tow car weighing, with load, 6 tons, to travel on level at a speed of 15 miles per hour; $K = 40$. What is the theoretical horse-power required?

The total load to be moved is 14 tons. H, for 15 miles per hour, is .400. Then $H \times WK' = .4 \times 14 \times \frac{40}{10} = 22.4$, the theoretical horse-power required.

2. Given a motor car, total weight 9 tons, to ascend a 7 per cent. grade at a speed of 6 miles per hour. What is the estimated horse-power required, with $K = 30$ lbs.?.

H for 6 miles per hour is .16, which, multiplied by $9 \times \frac{30}{10} = 4.32$ h. p., in overcoming the track resistances alone.

$H' = 2.240$, which, multiplied by $9 = 20.16$ h. p.; or nearly 4.7 times as much power is required to alone lift this weight at the rate of 7 feet in a hundred, than is required to move the car on a level at a speed of 528 feet per minute. This comparison incidentally shows the vast influence which grades on a railroad exert in increasing the power required to move the cars, and the importance and economy of selecting routes containing the least number of grades, and of ascending the same at the lowest practicable speed. The sum of the two will give the total theoretical, *i. e.*, 24.48 h. p. required. Allowing 50 per cent. as the combined efficiency of motors and gearing, to operate this car would require a draft of 48.96 h. p. upon the generating station.

3. A storage battery car, weighing complete, with load of passengers, 12 tons is required to ascend a 5 per cent. grade at a speed of 4 miles per hour; $K = 30$.

What will be the current required, assuming that the batteries give 180 volts at that time and that the combined efficiency of motors and gearing is 50 per cent?

$$H \times WK' = .1066 \times 12 \times \frac{30}{10} = 3.84 \text{ h. p.}$$

$$H' \times W = 1.066 \times 12 = 12.8 \text{ h. p., plus } 3.84 = 16.64 \text{ h. p.}$$

Assuming electrical and mechanical losses to amount to 50 per cent., we have 33.28 h. p. as the actual horse-power required. This, multiplied by 746, equals 24,826 watts, which divided by 180 gives 137.9 amperes.

Some constants for speeds of miles and fractions of miles per hour other than those given in the table may be obtained by interpolating and manipulating the constants for the various speeds and fractions given, by simple addition and subtraction. Thus the constant for a speed of 9¾ miles per hour will be the sum of the constants for 9 miles + ¾ miles; that is, $.020 + .240 = .260 = H$. Various constants for the grades may be obtained by a similar process.

In order that calculations for the horse-power of traction shall be of practical value some knowledge must exist of the correct value to be given K under various conditions, of the allowances to be made for the temporary increase of power required to start the car quickly, and of the wind resistances when running, of the increased power consumed in overcoming curves, switches and obstructions, of the efficiency of the motors and of mechanical losses, predeterminations of some of which are difficult, if not impracticable, to arrive at by simple calculation. Suitable provision for these and the exigencies arising in public traffic come within the experience of the traction engineer, a thorough knowledge of which, to be successful, must constitute a prominent feature of his education.

ON KINETIC STABILITY WITH MAGNETIC FORCES.[1]

BY PROF. G. F. FITZGERALD.

If a perfect conductor move near a magnet there are currents induced in it which tend to stop the motion. If the conductor be perfect, the kinetic energy of motion will ultimately, if small enough, be all changed into electro-kinetic energy, and the conductor will begin to move in the opposite direction, and when in its former position its electro-kinetic energy will have been reconverted into kinetic energy. For instance, if a perfectly conducting shell were placed near three magnetic poles it would be in a state of kinetic equilibrium if the energy given to it by a small disturbance were not great enough to drive it to infinity, or into contact with the magnet. It is to be remarked that I have assumed the perfect conductor to have been brought within a finite distance of the magnet pole without having had currents induced in it, *i. e.*, I have assumed that the body can be brought up as an imperfect conductor, and then changed into a perfect conductor, *in situ*. As the effect of a magnetic pole is to induce in a perfect conducting plane sheet currents which can be magnetically represented by a pole at the reflection of the first pole in the sheet, it follows that with a perfect conducting sheet there would be no action such as, in Arago's experiment, prevents motion of the sheet parallel to itself. There would, no doubt, be a gradual radiation of the energy due to the varying magnetic field. This would have a damping effect on the vibrations much the same as would result from resistance in the conductors.

The system is interesting as an illustration on a large scale of how meteoric swarms have their energy gradually frittered away into electro-magnetic radiations.

ELECTRICAL ENGINEERING IN SIAM.

Mr. A. J. Lawson, the well-known electrical engineer, who was formerly Canadian agent of the Edison Co., and lately represented the Brush Electric Co. in the Dominion, has received the appointment of superintending electrical engineer to the Siam Electric Light Co., of Bangkok, Siam. This company has bought a Mordey alternating current plant of 10,000 lights in England, and Mr. Lawson will have charge of its construction and operation.

1. Abstract of a Paper read before the British Association in Section A, Leeds, September, 1890.

ELECTRICAL ENGINEERS.

EMILE BERLINER.

For so young a man, Mr. Emile Berliner has certainly had a most varied experience, and to hear the story of his life from his own lips is not one of the least pleasures of acquaintance with him. The old German city of Hanover gave him birth in 1851, and after receiving an ordinary education he went into a dry goods store to learn the business. Possibly the goods around him set his fancy to work, for it was in this employ that he constructed a small model of a new type of weaving machine. Like many another young genius he was disgusted to find that he had been anticipated.

In May, 1870, he emigrated to the United States, and took a position as clerk in a fancy goods house in Washington, where he stayed nearly four years. In 1874, he ventured on to New York to see life—and saw it. Facile, courageous, inquiring, he was not disheartened by the buffets of fortune, but when work failed him in one line, turned readily to another. He took up anything that offered a chance to make a living. He clerked, kept books, taught German, painted backgrounds on enlarged tin-type portraits, and sold glue. Occasionally he practiced abstinence involuntarily by getting along on three dinners a week, but combined high thinking with plain living by spending nearly all his leisure hours in the library of Cooper Institute. After a brief Western experience as a drummer up and down the Mississippi, he drifted back in 1875 to New York, and secured employment as assistant bottle-washer in Fahlberg's laboratory for sugar analysis, at $6 per week. The occupation was a dreary one, but learning thereby the Scheibler method of analyzing raw sugar, he constructed a calculating machine for rapidly resolving the percentages of water, crystals and syrup. Fahlberg, it will be remembered, afterwards discovered saccharine. He had three big balloon blue-stone cells, the first galvanic batteries Berliner had ever seen, and was greatly enraged when he caught his inquisitive bottle-washer examining them critically one day.

Finding he could obtain no advance of salary in this position, Berliner went into a feed store on South street as bookkeeper and assistant salesman, and to this day is knowing in oats, meal, hay, corn and the eccentricities of Gotham's wagon drivers. In 1876 he chanced to meet his old Washington employer, who did not have much difficulty in persuading him to go back and assume charge of the retail department.

It happened that in 1874, a friendly German apothecary in New York had presented him with an old edition of Müller's "Physik" (1856), and from that he learned the rudiments of science, becoming particularly fascinated by sound and electricity. Soon after he stumbled across Paul La Cour's researches in phonic wheels, and this drew his attention to the possibility of transmitting speech by telegraph wire. The idea possessed him day and night. His first notion was to connect two vessels filled with mercury, by a wire, and pass a current through. Talking to one mercury surface, he reasoned, should vibrate the current and emit the sound at the other vessel. Lippman's capillary telephone nearly realized this conception. Returning to Washington, in 1876, with the fever of research upon him, he began electrical experiments, and, for the purpose of learning something of practical work, paid frequent visits to the Fire Alarm headquarters, where the operators, as is their wont in every office, were kind and ready to answer all questions.

Mr. Berliner had just begun making diaphragms and contacts, and had looked up Bell's patent of 1876, when one day, Mr. Richards, an operator, showed him, at his request, how to manipulate a telegraph key à la Catlin. "You have to press down harder," said Richards, "otherwise it may happen that the sounder at the other end will not respond well." The remark had probably been made a few million times before, but it had not been made to a Berliner; and the young dry goods clerk immediately wanted a thorough explanation of the phenomenon. "It flashed on me," he says, "that if pressure made a difference in an electrical contact, and modified the current passing the contact, a vibratory contact would transmit speech by means of undulatory currents. In this manner, the telephone transmitter, now known as the microphone, was invented." He set to work at once to study the principle just enunciated and tried to transmit speech, using for receiver an apparatus as shown in the Bell patent of 1876. For a transmitter he used metallic diaphragms, touching screws tipped with either platina, steel or broken lead pencil points. One day in April, 1877, he had adjusted the transmitter—a soap box and a black sheet-iron diaphragm against a steel ball—to the utmost nicety, *i. e.*, an extremely loose contact, and, closing the two wire ends leading to the battery he suddenly heard a scraping sound coming from the transmitter. He had discovered, in fact, that a microphonic contact could be vibrated by a current, and that such a transmitter would act as a receiver of sound as well.

How he followed up these interesting results, we will let Mr. Berliner himself tell. "This analogy with the Bell telephone," he says, "struck me very forcibly, and immediately making a duplicate transmitter, two days afterwards I actually transmitted speech and music with these two simple contrivances, almost as simple as a lover's telegraph. This work was mostly done before, or after, business hours, or on Sundays. I now tried all sizes of instruments, and various metals as diaphragms, and finding that distance would weaken the effect very considerably, hit upon the idea of placing the transmitter in the primary of an

induction coil, thereby transforming the undulations into high tension currents, passing these over the line wire, and re-transforming them again into low tension currents at the other end, to actuate the microphone receiver. No Bell telephones were used in these tests, but each instrument was used both for transmitter and receiver. My patent for this was issued Jan. 15, 1878, and was later re-issued. Without this, practical telephone work would be impossible. When, soon afterwards, I was introduced by a prominent Washingtonian, Mr. A. S. Solomons, to Prof. Henry, this great scientist was particularly pleased with the use to which I put the induction coil. I mentioned to him at the time that telephone circuits were found to be affected by parallel wires on which Morse signals were sent. He then related to me that he himself had traced signals on long lines between two wires which were a mile apart.

"I made some attempts to interest practical electrical men in the transmitter principle, and in Jan., 1878, visited the New York local branch of the Bell Telephone Co., but they refused to pay a very modest sum for the invention, which was then not yet perfected. It was not until during the summer of the same year that, by request of Mr. Anthony Pollock, the attorney of the Bell Co., Mr. Thos. A. Watson, general superintendent of the Bell Co., visited Washington and examined the transmitter, when he immediately declared that his company would want it. As one of my conditions, I asked to become a member of their electrical staff, and a contract was closed in Sept., 1878, in New York. Returning to Washington, a few nights later, to prepare for leaving, I sank into a severe nervous prostration, which lasted seven weeks, and from the effects of which I suffered many years afterwards. Leaving the hospital, I went to New York to enter upon my new duties."

Mr. Blake had just invented his transmitter, but it was not yet possible to control its functions in such a way that a number of instruments could be made of like quality, for when they were adjusted in the evening, they would be out of working order the next morning. Mr. Blake was taken ill similarly as Mr. Berliner had been, and the task of getting the instrument into a reliable construction was placed in Mr. Berliner's hands. After several months of labor, the conditions and gauges of the transmitter were so modified, and the rules were so laid down, that thereafter 200 transmitters were turned out per day, working alike in quality, and keeping the adjustment to perfection. One of the improvements consisted in re-baking the carbon buttons in a hydrocarbon gas retort, which made them very hard and susceptible of a fine and lasting polish. During the next few years Mr. Berliner's time was occupied with experimenting for the Bell Co., and in watching the manufacture of their instruments in Boston.

In 1881 he paid a visit to Europe, and laid the foundation for a telephone factory in Hanover (now J. Berliner's), which has since introduced one of the modifications he invented—the so-called "Universal Transmitter," which can be used under all conditions with like superiority, and is exclusively used by the Austro-Hungarian government, and in other countries. The line Buda-Pest—Vienna—Prague, 800 kilometres long, is fitted up with 50 of these instruments.

Returning to the United States, Mr. Berliner married Miss Cora Adler, of Washington, a lady whose bright and cheerful temperament has done much to help him in the cares and burdens to which the sensitive inventor is always heir. They moved to Cambridge, Mass., where he made the first studies which led on later to the gramophone, and where he conceived also the principle of his pyromagnetic generator, for which he filed a patent application as far back as 1885. Leaving Cambridge for Washington, he established a small laboratory on his return to the latter city, and devoted himself to a number of problems, foremost among which were those connected with the gramophone. This invention, the details of which are now familiar, Mr. Berliner considers his most important published invention to date. Not only does he expect to found a new art on it, but he believes that there will be an agreement of scientific men on the superiority of the principle of the gramophone, over that of the phonograph, in the perfect preservation of the voice and of sounds generally.

In 1889, he paid another visit to Europe, and has since formed a company for introducing a small sized gramophone. This company has orders for many thousands of such gramophones, which can be sold retail at $10 apiece, and orders for over 70,000 copies of 5-inch discs. These copies are made by making an electrotype matrix of the original sound etchings, and this matrix is impressed in celluloid, a material excellently adapted for gramophone discs. Laboratories have been established in Berlin, Leipsic, Frankfort and Hamburg, and soon each city will have a gramophone office where voices can be taken in solid metal, and copies furnished in the same manner as photographs are now made.

As soon as Mr. Berliner has got out an American programme, a public exhibition will be given before the American Institute of Electrical Engineers, to show the results with the latest improvements.

It deserves mention that while Mr. Berliner was last in Berlin, Prof. Helmholtz called on him with eighteen assistants of the Imperial Physical Laboratory of Charlottenburg, to inspect the gramophone and invited him to visit Charlottenburg as soon as the further developments in the invention were made.

Like other thinking electrical engineers, Mr. Berliner has made a favorite study of the problem of turning the energy stored up in carbon into electricity without the intervention of a steam engine. He believes the problem to be entirely solvable, but only by continuous original research and by leaving the beaten, dusty path of investigation on the subject.

Touching the theory of the microphonic action of loose contacts, he long ago held that it is the layer of air or gas between loose contacts which, acting as a variable resistance on increasing or decreasing thickness, produces the undulations; and that carbon is such an excellent material for a transmitter because it has the property of condensing a cushion of air upon its surface.

Among Mr. Berliner's other inventions of interest to electricians are his molecularium and his secondary battery. The former is an instrument of very simple principle, to illustrate the effect of the electric current by means of a single mechanical movement, that, namely, of the rotatory vibration of molecules. In his storage battery, 5 per cent. of alcohol is added to a Planté type of cell, with the result that fresh lead plates form in a few minutes. This, he thinks, is due to the formation of ozone in such a cell. Mr. Berliner has also brought out a superior spongy carbon, obtained by heating ordinary battery carbon to redness for several minutes in an open fire. This burns out the lighter hydrocarbons, leaving a spongy or capillary structure which increases the power to depolarize and decreases the resistance. In such a spongy carbon, the gases will themselves give cause to currents if a piece of unburned carbon be used as the other electrode.

LONDON ELECTRIC SUPPLY COMPANY.

The machinery at the Deptford station is working in a highly satisfactory manner. The current that is now being daily generated is greater than any that has yet been supplied. Both the 1,500 horse-power engines and dynamos are working without any hitch, and have been supplying current continuously to about 40,000 lamps every night for about a month through the Ferranti mains. The disturbing effect on the telegraph lines has now been reduced to an insignificant and hardly appreciable magnitude. For reasons which are not yet thoroughly understood there is a rise of pressure of nearly 50 per cent. at the ends of the mains.

THE CUSHING ELECTRIC SWITCH-BOARD FOR THEATRES.

THOUGH eminently adapted to harmonize with interiors of whatever style of decoration, the electric light has probably found no better field of application to show the full value of its light-giving, healthful and safe character than in the illumination of theatres. As a result of this it may be safely stated that every theatre of prominence now uses electricity, at least in part, as an illuminant.

The introduction of the electric light in theatres has, of course, made it necessary to provide arrangements for the manipulation of the lights in order to obtain the effects which had heretofore been obtained by means of gas. It therefore became necessary to provide means for working the various circuits in a variety of ways involving quite a large number of combinations of circuits, while at the same time requiring the independence of each particular circuit when the effect desired made it necessary. To fulfill these conditions successfully is evidently no small task, when we consider the large number of circuits with which a theatre is provided, and, above all, the fact that the entire manipulation of the lights must be done by one man.

This particular branch of theatre lighting has been the subject of much study and indeed may well claim the attention of electric light engineers both from the electrical and the mechanical standpoint. As an example of this class of work which deserves attention from the thoroughness with which all the details have been worked out, we desire to bring to the attention of our readers the new switch-board which has just been placed in Herrman's Theatre, in this city, and which was built by Messrs. John P. Cushing & Co., of Boston, after designs by Mr. Wm. J. Kelly.

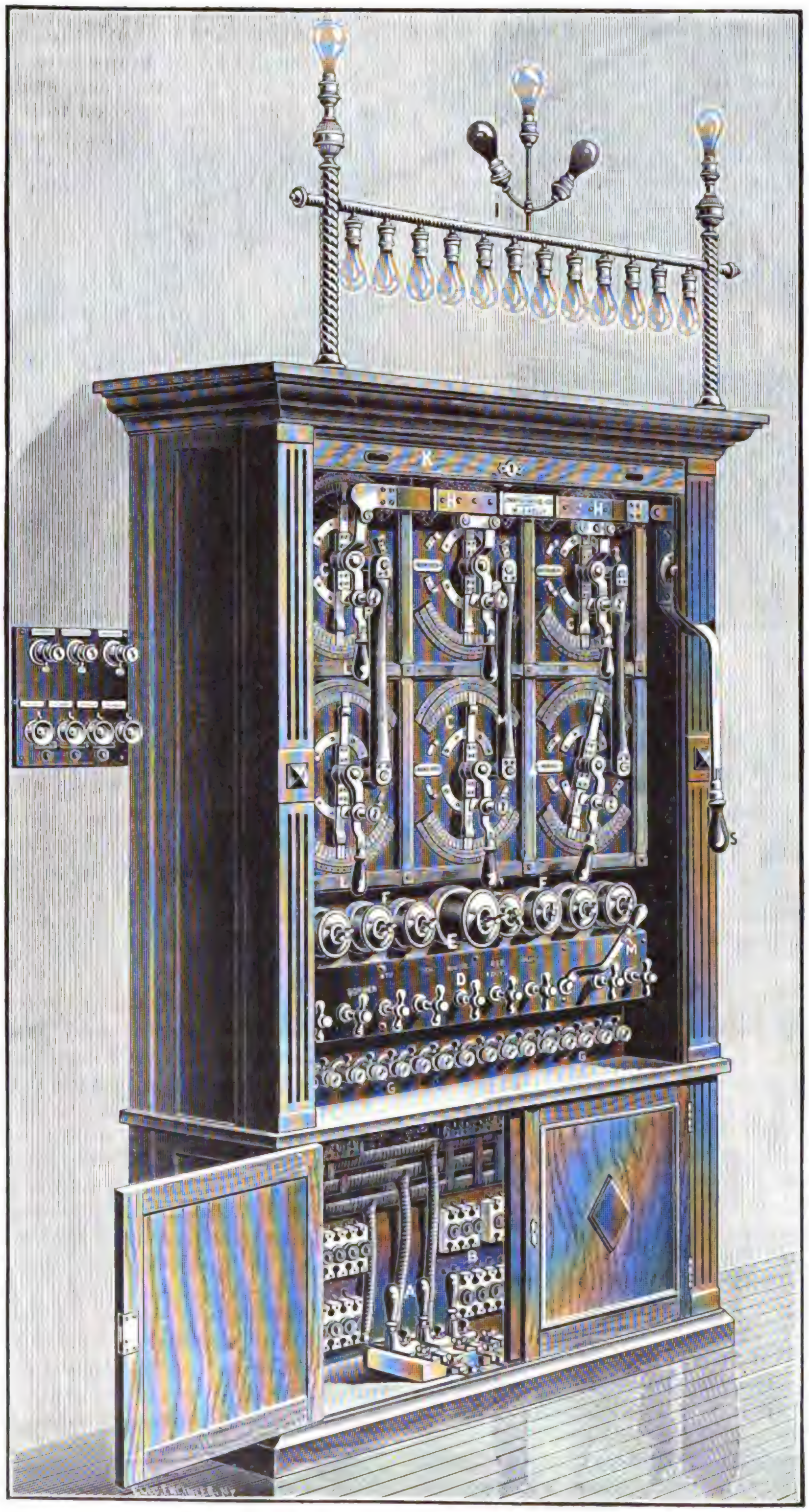


FIG. 1.—CUSHING'S ELECTRIC SWITCHBOARD, HERRMANN'S THEATRE, NEW YORK CITY.

The board which is illustrated in the accompanying engraving has been constructed with special reference to insulating and fireproof qualities and for that purpose the entire switching apparatus is mounted on plates of molded mica. Every possible care was taken in these details. The wiring has been arranged for the three wire circuits entering the building from the Edison street mains on Broadway, and the main circuits are led directly to the base of the board which forms a cabinet containing the feeder plugs and cut-outs. The former, shown as A, when unplugged, cut off the entire current from the switch-board, so that no current can reach any part of the house unless specially fed by an independent wire, for accommodation light. By this means all danger from fire is eliminated.

The fusible cut-outs B contained in the cabinet are included in the different circuits controlled by the switch-board. The safety fuse, being properly marked with its ampere carrying capacity, can at once be replaced in case of its being blown.

After passing through the safety cut-outs the wires pass to the main house and circuit switches E and F, which are arranged in one row. These switches are of sufficient capacity to supply any current necessary for the auditorium. From the main house switch E the smaller switches at the sides are branched, which control the parquet, balcony, gallery, private boxes, bulls-eyes, etc.

Immediately below these switches are those controlling the lights on the stage and shown at D. Among them is a gang-switch M, which, by a single movement, switches in or out, one, or all the lights or combinations of lights on the stage, an effect which has not heretofore been accomplished.

Before proceeding to explain the full effects which can be obtained by this switch, it will be necessary to describe the regulators C, which are in connection with the resis-

tance coils. These regulators are designed to produce any change from full light to darkness without switching the current entirely off. For this purpose the resistances which are in series in the circuits have both positive and negative ends connected to the regulators, the switch arm, pivoted at the centre, passing over a series of contact segments at each end.

Each of the regulator handles L is provided with a spring pin P, which, when withdrawn, allows the switch to be worked independently so that its operation effects only the lamps connected to it. These switches, it will be noted, regulate both the stage and the house lights.

It is frequently desirable, however, to regulate all the lights in unison, or, on the other hand, to bring lights on two or more circuits to a certain brilliancy without affecting those in any other circuit. To accomplish this with certainty, the board is provided with a very simple movement, consisting of a lever, S, which, operating through the horizon-

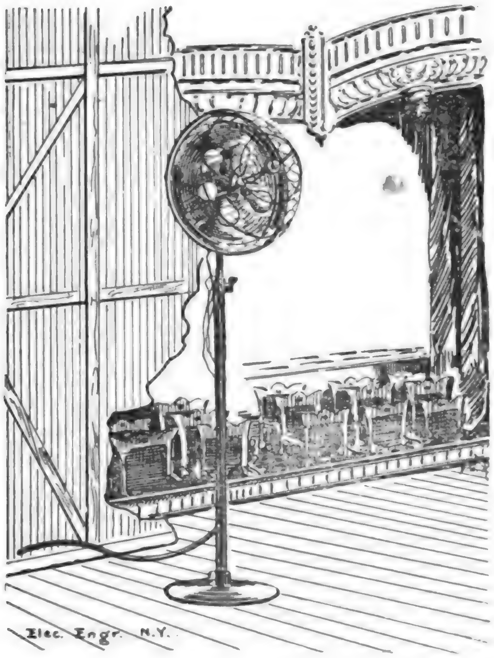


FIG. 2.—COMBINATION BUNCH LIGHT.

tal and vertical connecting rods, H and M, allows of the movement of all, or any combination of, the regulator switches which may be required.

As has been remarked above, the spring pins P, when withdrawn, allow of independent movement of the switches, But when released, they engage with the movement connected with the lever S and are moved accordingly. Thus. if all the pins are released, which is done by a turn of the milled head, the lever S operates all the regulators to bring the lamps on those circuits to uniform brilliancy; but the withdrawal of any pin, such as that belonging to the bunch lights in the lower left-hand corner, leaves the lights on that circuit unchanged.

In order that the attendant at the switchboard may know the exact condition of the illumination in every part of the house, each circuit is provided with a pilot light. These, as shown, are placed at the top of the case at I, and give an exact representation of the brilliancy of the lamps in each particular circuit, and show at the same time whether the circuits are in working order. At the same time, however, each pilot lamp can be controlled independently and extinguished, if desired, by the horizontal row of switches shown at G.

Just what effects can be produced by the arrangements we have explained will now be understood. Thus, if white foot lights and borders representing daylight are in use at the rise of curtain, and red is required for sunset, the stage lights are drawn into the resistances, the white foot lights are snapped out and red thrown in. This is done by one movement of the lever S. The border lights are gradually worked up to the height required for sunset, the foot light regulator disengaged and the foot lights worked up slowly, producing sunset effects. For moonlight effects, all lights are worked down again, the reds drawn out and, by the same movement, the blues thrown in and the foot light regulator worked up until the proper effect is produced.

The gang switch, D, operates all the other snap switches when a little pin on each switch, is inserted; and any switch which is not desired to be operated is kept free by pulling out the little pin, precisely in the same way as described in connection with the resistance switch.

With the stage gang switch D, any and all stage lights can be thrown in or out, together or alternately, as for instance first and fifth border, red, white, or blue foot lights; second, third and fourth borders, bunches and sides; thus making it possible to make any changes in lighting that may be desired, all being done by and under the control of one man.

The board which we have just described is enclosed in a polished hard-wood case and when not in use a roll front is drawn down, thus enclosing the whole and preventing the entrance and accumulation of dust.

The theatre is also provided with combination bunch lights of an improved form, designed by Mr. Kelly. These, as shown in the engraving, Fig. 2, consist of a cluster of six incandescent lamps placed in front of a polished reflector and protected by a wire netting.

Centered on the same point as the incandescent lamps, are a bunch of gas burners. The latter are fed by a rubber hose, while flexible cords serve to carry the current to the lamps. The latter, with the reflector, are mounted upon a rod which telescopes into the standard so that the bunch can be fixed at any height and at any angle.

Another device introduced consists of a series of lamps mounted in front of a curved reflecting surface and provided with glass fronts having different colors; these can be readily manipulated both as to position and color and thus afford a good substitute for the lime or arc light.

Besides the board installed in Herrmann's Theatre, a similar one has been placed in the Tremont Theatre, in Boston, and another in a Brooklyn theatre and the managers of all express their utmost satisfaction at their operation.

THE PARIS TELEPHONE SYSTEM.

Beginning with Nov. 3, any subscriber to a telephone, and any person entering the telephone offices, will be allowed to speak to any of these offices a message to be transcribed and conveyed to a person living in the district. The charge will be 50 centimes for five minutes, and the message will be limited to 100 words. The work of altering and enlarging some of the main sewers, with a view of facilitating the connecting of the new central telephone exchange in the Rue Gutenberg with the various subsidiary exchanges, is now being vigorously pushed on. In some instances the sewers will be entirely transformed. Thus in the Rue Faubourg-Montmartre the tunnels will be about 13 ft. broad by 10½ ft. high, with a sewer course 4ft. deep in the middle. On either side of this channel there will be a platform 2ft. wide, one of which will be used by the Municipal Sewers Department, while the other will be given over to the telephone service. The roof of the tunnel will rest on cast-iron pillars, and on brackets fixed to these will be run Patterson 50-wire telephone cables. The cost of this work will be shared between the Municipality and the Postal Telegraph Department.

TAKING TEMPER OUT OF PENS.

"Young man, you must take more pains with your writing." The youth looked up and replied: "'Tain't my fault; it's the pen." "Then get a new pen," replied the teacher sharply. "That won't do any good," the boy made answer, "for the electricity in the street cars throws all the temper out of the pen." "It would be a good thing if it had a similar effect on the children," said the teacher *sotto voce*.—*Albany Journal.*

ELECTRIC LIGHTING IN THE CHAMBER OF COMMERCE BUILDING, CHICAGO.

BY CHARLES WIRT, E. E.

ONE of the most striking features of the modern tendency towards centralization is to be found in the erection of immense office buildings in which the merchant or professional man is now provided not only with room to transact his business but is afforded all the comforts and conveniences which are so conspicuously absent in the older

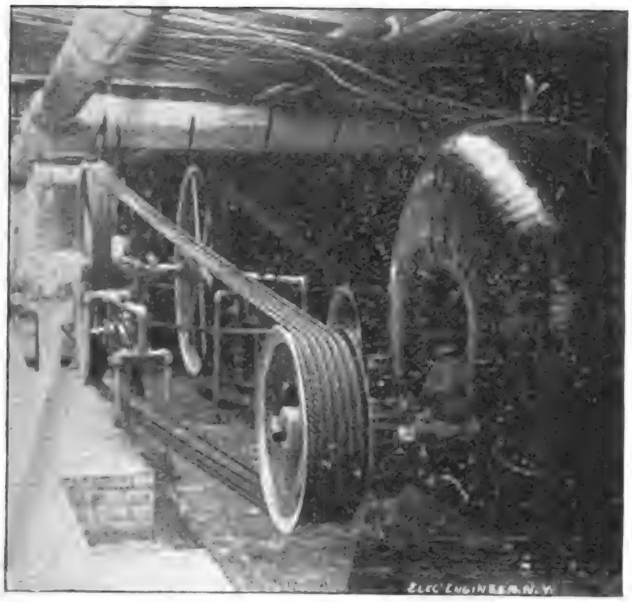


FIG. 1.—MATHER GENERATING PLANT, CHICAGO.

buildings devoted to business purposes. Among these features of advantage probably none stands out more prominently than the electric light, and it is safe to say that at present no modern office building is erected without provision being made for its installation; indeed, not a few are in existence in which this is the only form of illumination provided, such has been the confidence developed by the experience of but a comparatively short time.

The city of Chicago, already famous for its enormous office palaces, has now added another to the long list in the completion of the Chamber of Commerce Building, which, with its thirteen stories, is the highest commercial structure in the city, and, with one exception, the largest. To light this enormous building an incandescent plant of the Mather system was installed by Mr. Bow, Western manager of the Mather Electric Co., consisting of four 00-light Mather incandescent dynamos. These are driven by two 150 h. p. Corliss engines, built by Messrs. Weisel and Vilter, of Milwaukee, Wis.

The limited space available for the placing of the machinery made its arrangement a matter of no little skill, the engine room being 11 ft. 6 in. wide by 113 ft. long. An interesting feature of the construction is the rope driving which is illustrated in the accompanying engravings and which is used both for the main belt of the engine and for the dynamo belts, Figs. 1 and 2. The engines run 88 revolutions per minute, have driving wheels 9 ft. 6 in. in diameter, weighing 24,000 lbs. each, and are grooved for ten one-inch raw hide ropes. The dynamos are driven from the counter-shaft by five ¾ inch raw hide ropes, the slack of which is taken up by an improved single track tension carriage. This arrangement of driving ropes, which was installed by the Link Belt Machinery Co., of Chicago, is found to run very smoothly and quietly. The sheaves that drive the dynamos are each provided with disc friction clutches, so that either or both machines can be run at will.

The number of lights in the building is 3,400, and the lighting of the interior court, which is 13 stories high, is by clusters of 7 lamps placed 16 feet apart, all the way around the court on each floor.

The building is a fine example of modern fire-proof construction, showing what can be done in a limited ground space with the methods of modern constructive engineering.

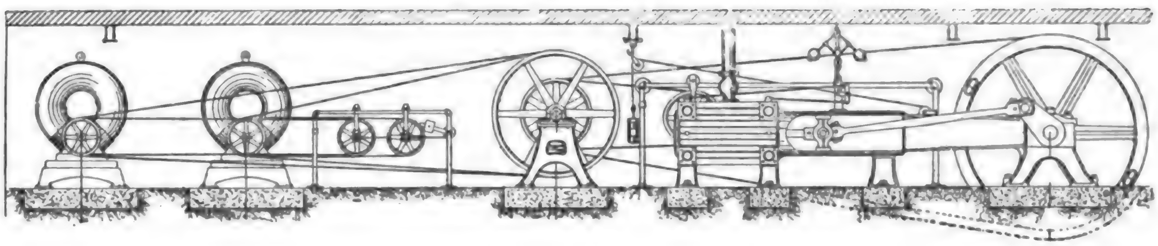


FIG. 2.—ELECTRIC GENERATING PLANT, CHAMBER OF COMMERCE BUILDING, CHICAGO.

CATAPHORIC MEDICATION.

THE question of the absorption into the skin of solutions by means of electric currents has been, according to Dr. S. Ehrmann, of Vienna, the subject of many experiments with him since Prof. Wagner first started the discussion by his researches on the cataphoresis of cocaine; and he has at last hit on a very simple experiment. Take two similar glass vessels, with zinc electrodes at the bottom, and filled with a very weak solution of methyl-blue; and if an individual places one of his hands in each vessel, then when a constant current of from 10 to 20 milliamperes is allowed to pass for five or ten minutes the hand in the anode vessel becomes covered with blue spots, whilst the other is not marked. The spots appear most on the back of the hand, where the hair and fatty glands are situated. In the palm and around the nails they do not occur.

ELECTROSTATIC FORCES BETWEEN CONDUCTORS CARRYING CURRENTS.[1]

BY DR. O. J. LODGE.

BOYS had in vain attempted to measure the mechanical effect and also the thermal effect first observed by Gregory, who thinks the forces too small to be observed. Dr. Lodge pointed to some curious conclusions. He thinks that a small electric oscillator radiates to a moderate distance with greater intensity than terrestrial sunlight; but it must be remembered that if steady sunshine were as intense as the intermittent artificial radiation, metals would not only get heated by Foucault currents, but would send out torrents of sparks to contiguous pieces, especially when some period of solar vibration happened to agree with their own. The energy of solar radiation, however, is spread over a considerable range of wave length, the greatest portion of it being embodied in extremely short waves somewhat below the red end of the spectrum; whilst the energy of an artificial radiator is embodied in very much larger waves, mostly all of the same size.

1. Abstract of a paper presented at the British Association Meeting, Leeds.

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VOL. X. NEW YORK, NOVEMBER 19, 1890. No. 133

In a thousand years from now, or even sooner, the people who exist then may have minds that can see and understand easily phenomena which are now a mystery to us. We may be looked upon as an ignorant race, and what we have done considered nothing.—Thos. A. Edison.

THE VALUE OF THE STEAM JACKET IN ELECTRICITY.

IN one of his addresses Sir William Thomson has remarked that the electrical engineer ought to be nine-tenths a mechanical engineer, thereby indicating his observation of the fact that much of the work of the electrical engineer is mechanical in its nature. This statement need not be taken in its exact, literal phrasing; the truth and value are to be found also in its application. It certainly is true that the electrical engineer of to-day in designing and laying out work, involving lighting, power, electro-deposition or the like, is constantly called upon to devise the best plans and arrangements involving the use of steam; and hence in order to carry out his work intelligently, a thorough knowledge of steam engineering ought to be a part of his professional equipment. Ever since electric lighting became an established industry, for example, a discussion has been carried on as to the best type of engine to be employed for driving dynamos. The two factions which have been most prominent in this are, of course, those favoring respectively the high speed and the slow speed engine. While the discussion on this basis may be said to have left the question still unsettled, more recent controversies have somewhat shifted the field of battle so that now it may be considered to be one involving units of power, and leaving the question of the particular type of engine a little in the background.

The points now coming up are of the first interest to electrical engineers. The experience of the past has shown that the coal economy which can be derived from either type of engine *per se* can be made alike, practically, provided each is run *at its maximum capacity*, and hence when units of power are adopted and the arrangement is such that each is operated at its best load, the question of the type of engine is under these conditions no longer a matter of paramount consideration, so far as coal consumption is concerned. The relative cost of engines and floor space occupied by the two types for the same power is another matter, which, though entering into the calculations, does not bear upon the main point. But there are still some other points in steam engineering practice in which the electrical engineer is deeply interested, and one of these is the value of the steam jacket as an economizer of fuel. The father of the modern steam engine, Watt, was the first to recognize the value of maintaining the cylinder at as high a temperature as that of the steam entering it, and for that purpose first applied the steam jacket. Since that time the practice has been followed to a very large extent, yet strange to say, after one-hundred years, authorities still differ on the relative value of this adjunct to the steam engine.

In the paper just read by Prof. R. H. Thurston, at the Richmond meeting of the American Society of Mechanical Engineers, the author presents a magnificent résumé of facts and current opinions, as well as of authorities, on the steam jacket. After reciting the experiments of Watt, he traces the results obtained by a large number of steam engineers, who quite generally concede the value of the jacket, but who agree that the exact economy obtainable varies considerably with the nature of the engine and the conditions under which it is worked, depending upon the ratio of expansion, and whether the steam is worked in one or more cylinders, etc. The fact is also brought out that besides the steam jacket, the super-heating of steam prior to its introduction into the cylinder is another efficient means, and, under some circumstances, a more efficient one for preventing loss and condensation in the cylinder. Attention is also drawn to a fact which deserves more consideration than has been given to it in the past, namely, the application of hot gases from the chimney as a means of maintaining the temperature of the cylinder at its proper value.

With some of the best authorities agreed on the fact that steam jacketing involves a gain of from 15 to 20 per cent., the statement is also made by Prof. Thurston, and should be brought out prominently, viz., that a large proportion of the steam jackets in use are steam jackets in name only. Owing to the accumulation of water, or of air, or both of them, arising from the careless manner in which they have been made, or laziness on the part of the attendant, the ends for which the jackets are designed may not only be entirely frustrated, but they may even become a source of additional waste. Thus, instances are cited in which the jackets have been actually shut off and allowed to fill with water by the attendants in order to keep the engine room cooler! The pernicious effect of such carelessness is too obvious to require further comment.

It is curious to note, however, the more modern opinions on this subject, especially those of some of the designers of modern high speed engines. Thus the experiments of the Westinghouse Co. on their "Duplex No. 1," an engine

having both cylinders partly jacketed, showed no appreciable effect of the jacket, the saving of steam in the cylinder being fully equalled by the condensation in the jacket. Mr. F. H. Ball's experience indicates a measurable saving, but not enough to be considered important; his compound engines are, therefore, not in this respect improved by the addition of the jacket. It would, therefore, seem, and has also been expressed by some of the authorities, among them the well known engineer, Mr. John W. Hill, that the jacket is of unquestionable benefit when used under proper conditions and may be expected to improve the economy ten per cent. and perhaps more in some cases; but that the jacket is better adapted to low-speed high-expansion engines than with the higher speed modern engines of to-day, and that with the modern high pressures and initial temperatures, the value of the jacket becomes of comparatively little importance. Much also depends, as above stated, on the ratio of cut-off, the shorter the latter, the greater the gain of the use of the jacket.

We have deemed it well to devote this space to a brief résumé of Prof. Thurston's admirable paper and we hope that our readers who may have had experience in the application of the jacket will take up the matter and that it may lead to a discussion which will help throw more light on this important subject.

THE DIVIDED-EXCHANGE MULTIPLE SWITCH-BOARD SYSTEM.

In our issue of September 10, we published a description of the divided-exchange multiple switch-board system, invented by Mr. Milo G. Kellogg, of Chicago. Our description was founded upon one of Mr. Kellogg's United States patents, issued March 25, 1890, the application for which was filed December 8, 1887. A synopsis of the patent with drawings, claims and date of application, appeared in the *Official Gazette* of the Patent Office for March 25, 1890. We notice that substantially the same system is described by Mr. E. Bouchard in the issue for May and June, 1890, of *Annales Télégraphiques*, Paris. In view of the date of Mr. Kellogg's application for a patent, Mr. Bouchard's work on the same lines would seem to be subsequent to that of Mr. Kellogg.

This system of operating telephone exchanges promises to be of much value in the larger and growing "centrals," and seems likely to do for such exchanges what the multiple switch-board has already done for exchanges that have hitherto been deemed large, in the saving of apparatus and labor. The multiple switch-board system becomes useful when an exchange has reached about five hundred lines, and avoids the necessity of trunk-line service between the several boards until about ten thousand lines are reached. The divided-exchange multiple system would become of utility in exchanges, say, of about three thousand lines, and would, apparently, avoid the necessity for trunk-line service between the several boards in exchanges of any size likely to be constructed; that is to say, for as many lines as can ever be brought into one exchange. In the multiple switch-board system, now so largely employed, there is one switch-board for about every two-hundred lines, and each line requires a switch on each board of the exchange. In the divided-exchange system the switch-boards are divided into several divisions (two or more according to the number of lines); the lines are divided into the same number of divisions. Each line has a switch on each board of its own division, and on one board only of each of the other divisions. Thus, with a two-division system, as compared with the ordinary multiple system, there would be only one-half as many switches plus one for each line, and practically twice as many lines can be operated with the same quantity of apparatus. With a four-division system there would be only one-fourth as many switches plus three for each line as are required in the ordinary multiple system, and nearly four times as many lines can be operated. It is obvious that further sub-division can be made as exchanges grow larger, with a similarly increasing rate of gain in apparatus and labor.

Mr. Kellogg has, we understand, worked out the divided system in its details for any number of divisions and for any system of exchange operation, whether for ground circuits, metallic circuits, or mixed lines. Telephone engineers will, we think, look with interest upon Mr. Kellogg's system and its practical operation in a large exchange.

LONG-DISTANCE BUSINESS COMMUNICATIONS.

The recent excitement in Wall street, and the sympathetic agitation in business circles, has, of course, been the means of keeping the wires very busy. The tickers have had all they could carry, and we understand that the Atlantic cables have also been subject to the strain of an enormous volume of traffic. The land telegraph lines are tolerably equal to the burden put on them, provided a little delay does not matter to the sender and receiver, but at such times as the recent ones the long-distance telephone service, abolishing delay, preventing ambiguity and bringing interested persons directly together, even if hundreds of miles apart, proves at once its value and superiority. Evidently wherever direct and swift communication is desired between parties widely apart nothing can possibly compete with the telephone, if available, but this is not as fully grasped by the financial and mercantile community as might be expected. A late experience of The Electrical Engineer has done more to inform us of the benefits of long-distance telephoning than any quantity of outside testimony could do in the way of conviction. The business manager of the journal being away in Philadelphia, he called up the New York office, whereupon a big batch of morning mail was read to him and replies were dictated to a stenographer in New York. So successful was the experiment, it has since been repeated more than once, and has become a practice on every such occasion. In this manner, continuity of work is kept up, no pressure or uncertainty is caused by absence, and both ends of the line are fully informed. We are not aware that the dictating of a heavy mail or scores of letters has been done before, but we can heartily recommend it as a new and successful feature of business economy and efficiency.

Lighting the New York Elevated Trains.

The statement recently made exclusively in The Electrical Engineer to the effect that the Manhattan Elevated Railway had been considering electric lighting for its cars, has been contradicted. The statement was and is, however, perfectly true. Col. Hain says that no plan has been formally accepted, and that $200,000 would be required. The fact that he names a sum at all is ample proof of our statements, which were to the effect that estimates had been made, even down to details.

ON THE BEST DIMENSIONS FOR STANDARD OPTICAL AMMETERS AND VOLTMETERS.—II.

BY A. E. KENNELLY.

Ammeters.—If the instrument is intended for an ammeter, it will be necessary to wind it with coarse wire up to the heat limit. The diameter which will attain this for a given maximum current, c amperes, is expressed by the equation

$$d^2 = \frac{a\,c}{\pi}\sqrt{\frac{8\,m\,\rho}{h\,q\,b}}, \tag{15}$$

where $b = a\sqrt{1 + \frac{4\,m}{\pi\,q}\left(\frac{D}{d}\right)^2}$, as before.

For example, suppose it were required to determine the most effective winding for an optical ammeter of 50 amperes maximum capacity, the length of tube being 80 cms., the winding diameter 1.3, and the weight of copper wire 8 pounds, the instrument to be kept permanently in circuit ($h = 0.01$).

Since the wire will be coarse, $\left(\frac{D}{d}\right)$ will be 1.02, say. Then $b =$

$$1.3\sqrt{1 + \frac{4 \times 8 \times 454 \times 1.02 \times 1.02}{3.14 \times 3.14 \times 1.3 \times 1.3 \times 80 \times 8.95}} = 1.956;$$

and $d^2 =$

$$\frac{1.3 \times 50}{3.14}\sqrt{\frac{8 \times 8 \times 454 \times 1.8 \times 10^{-6}}{0.01 \times 3.14 \times 1.3 \times 1.3 \times 80 \times 8.95 \times 1.956}} = 0.5489$$

$$d = 0.741, \text{ or } 0.292''.$$

The amplitude obtainable at full load in this case would be by (1), and (4),

$$\theta = 1.257 \times 50 \times 0.0420 \times 80 \times \left(\frac{1.956 - 1.3}{0.75 \times 0.75}\right) = 235', \text{or } 3°55'$$

subject to slight correction for polar influences, and for temperature.[1]

When the instrument is needed for an ammeter in a circuit containing resistance in such a degree that the heat limit cannot be reached, the above formulas no longer apply.

Let E be the E. M. F. of the circuit, and β its resistance.

Then $$c = \frac{E}{\beta + r};$$

whence $$\theta = \frac{4\,\varphi\,E}{10\,(b + a)}\sqrt{\frac{m}{\rho\,\sigma}} \times \frac{\sqrt{r}}{\beta + r}$$

Differentiating this with respect to r and equating to zero, we have for the maximum value of θ, $r = \beta$; or the resistance of the instrument should equal that of the rest of the circuit, and then

$$\theta = \frac{E\,\varphi}{5\sqrt{\beta}\,(b + a)}\sqrt{\frac{m}{\rho\,\sigma}}. \tag{16}$$

Substituting the values already stated for ρ, σ, and φ,

$$\theta = \frac{2.09\,E}{(b + a)}\sqrt{\frac{m}{\beta}} \text{ where } b \text{ is found by (8)} \tag{17}$$

To find d in this case, we have the relation

$$d^2 = \frac{4}{\pi}\sqrt{\frac{m\,\rho}{\beta\,\sigma}}; \tag{18}$$

or, $$d = 0.0239\sqrt[4]{\frac{m}{\beta}} \tag{19}$$

1. It may be remarked that in this case the calculated diameter of the wire (0.74 cm.) is too great for the coiling depth ($b - a = 1.956 - 1.3 = 0.656$) that eight pounds of wire spread over the whole length of tube will occupy. This discrepancy must occur whenever the weight of wire allowed is incompatible with the current strength to be measured, and the external radiating surface of the helix. The remedy in such cases is found in shortening the helix or increasing the weight of wire.

Thus, suppose the most effective winding to be found for an instrument to indicate the E. M. F. of one Leclanché cell of 1.5 volt, having a resistance of 1 ohm, using 10 pounds of wire and with the dimensions $l = 60$, $a = 1.2$ and $m = 4536$; $\left(\frac{D}{d}\right) = 1.18$.

Here $b =$

$$1.2\sqrt{1 + \frac{4 \times 4536 \times 1.18 \times 1.18}{3.14 \times 3.14 \times 1.2 \times 1.2 \times 60 \times 8.95}} = 2.49;$$

and $$\theta = \frac{2.09 \times 1.5}{2.49 + 1.2}\sqrt{\frac{4536}{1.0}} = 57' \pm;$$

while $d = 0.0239\sqrt[4]{\frac{4536}{1}} = 0.196$, or $0.077''$.

The above formulas enable the best size of wire to be found for all the conditions that are usually met with in practice. They have been proved practically reliable by experiment in the Edison Laboratory, the only constants about which there remains any uncertainty being the heat values 0.01, and 0.02, which are estimates fairly reliable.

The formula of correction for the polar influence of the helix upon its magneto-motive force, may be given in conclusion.

Let the accompanying diagram represent a longitudinal section through the axis of the tube and encircling helix. The tube is supposed to be set symmetrically in the helix, so that the distances d from the extremities to the terminal planes of winding are equal. While not essential, this adjustment is generally easy and abbreviates the correctional formula. Let l_1, l_2, l_4, l_6, be the distances, as shown, from one extremity of the axis in the tube, to the circumferences of the coil, while l_3 and l_5 are the corresponding distances to the mean circumference. Then equation (3) becomes more strictly

$$\theta = \varphi\left\{\frac{4\,\pi}{10}\,N\,c\left(\frac{l_5 - l_3}{l}\right)\right\}. \tag{20}$$

This formula corrects the length of the helix for the polar influence of a similar solenoid of like length and current turns, but of indefinite thinness fixed at the mean circumference. The amount of the correction is with long tubes so small, that this approximation is sufficient. When the correction needs to be made with more care, the formula is

$$\theta = \frac{2\,\pi\,c\,\varphi\,N}{10\,l\,(b - a)}\left\{b\,(l_6 - l_1) - a\,(l_4 - l_2) + D^2\log_e\left(\frac{l_6 + b}{l_4 + a}\right) - d^2\log_e\left(\frac{l_1 + b}{l_2 + a}\right)\right\} \tag{21}$$

where $D = l + d$.

This formula is often independently useful for the determination of magnetic differences of potential between points measured along the axis of a homogeneous coil, and equidistant oppositely from its mid-plane.

As an example, suppose the sodium line rotation to be required by computation from a uniform helix of 50,000 turns of length $l = 30$, and radii $a = 2$, $b = 4$, when carrying 0.1 ampere, over a tube 34 cms. long.

Formula (3) gives $\theta = \frac{4}{10} \times 3.142 \times 4.2 \times 10^{-3} \times 50,000 \times 0.1$
$= 263'.9 = 4°\,23'\,50''$.

By formula (20) $\theta = 4.2 \times 10^{-3} \times \frac{4}{10} \times 3.142 \times 50,000 \times$

$$0.1 \times \frac{(32.14 - 3.61)}{30} = 251'\,1 = 4°\,11'\,6''$$

By (21)

$$\theta = \frac{2 \times 3.14 \times 0.1 \times 4.2 \times 10^{-2} \times 50{,}000}{10 \times 30 \times (4-2)} \Big\{ 4\,(32.25 - 4.47) - 2\,(32.06 - 2.83) + 1024 \log_\varepsilon \left(\frac{32.25+4}{32.06+2}\right) - 4 \log_\varepsilon \left(\frac{4.47+4}{2.83+2}\right) \Big\} = 250'.5 = 4^\circ\ 10'\ 30''.$$

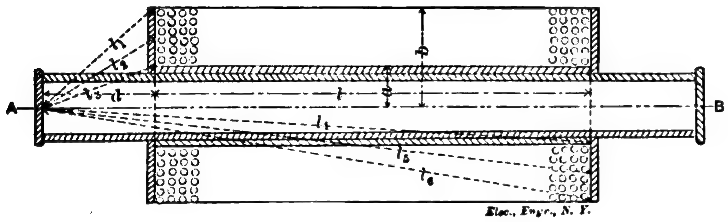
These equations of course enable the current to be determined in absolute measure when the amplitude of rotation is correctly observed, and the geometrical data of the winding are given.

The rotation obtained for a given current, really varies slightly with the temperature of the bisulphide of carbon liquid.

M. Bichat has given the following formula for reducing the rotation observed at one temperature, to that at another,

$$R_t = R_o\,(1 - 0.00104\ t - 0.000{,}104\ t^2),$$

where R_t is the rotation at t° c., R_o being the rotation at zero. From the standard value of $\varphi = 4.2 \times 10^{-2}$ and this formula, we have the following table of temperature values for the Verdet constant of carbon bisulphide:



Kennelly On Electro-Optical Measuring Instruments.

t° c	ϕ	t° c	ϕ	t° c	ϕ
0	0.04300	10	0.04249	20	0.04186
1	0.04295	11	0.04244	21	0.04179
2	0.04290	12	0.04238	22	0.04172
3	0.04285	13	0.04232	23	0.04165
4	0.04281	14	0.04226	24	0.04158
5	0.04276	15	0.04220	25	0.04151
6	0.04271	16	0.04213	26	0.04143
7	0.04266	17	0.04207	27	0.04136
8	0.04261	18	0.04200	28	0.04128
9	0.04255	19	0.04193	29	0.04120

RÉSUMÉ.

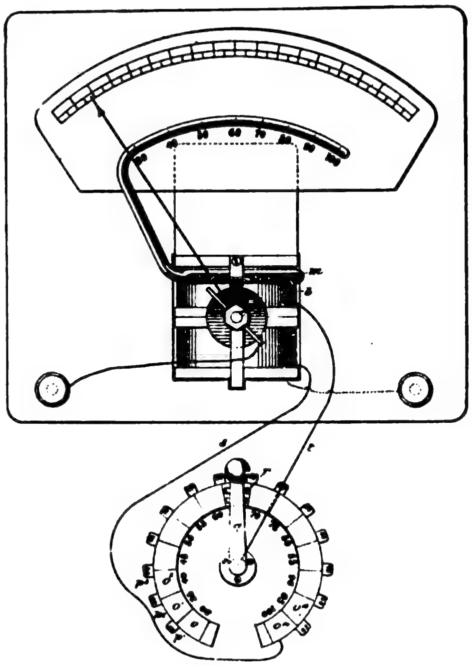
The amount of rotation obtainable from an optical ammeter or voltmeter, varies as the square root of the weight of copper used in the winding when used most effectively. It also varies as the square root of the ratio of length to internal diameter of helix, so that the length should be as great as possible, and the internal diameter as small as possible, consistent with good optical conditions. There exists a practical limit to which the rotation obtained from any such instrument is subject, owing to the heat developed in the coil by the current. This limit is about 25° according to the estimates here given for currents of short duration, and 18° for instruments permanently in circuit. No theoretical limits are however prescribed if the thermal effects can be obviated. The best sizes of wire to employ for different instruments when the dimensions of the tube and weight of wire have been decided upon, are given in formulæ with examples, together with corrections for virtual length, by which currents can be determined from good apparatus in absolute measure with an accuracy of at least one part in 750.

WESTON'S TEMPERATURE REGULATOR FOR MEASURING INSTRUMENTS.

Among the errors to which electric measuring instruments are subject, is that due to the heating of the coils by the passage of the current. This evidently increases their resistance and changes the value of the readings indicated. To avoid this as much as possible recourse is had to wire having as low a temperature coefficient as possible; but such wire of German silver or platinoid is very expensive when the finer sizes are employed, and hence it becomes desirable to retain copper wire if some means can be provided for correcting the error due to the change in resistance resulting from temperature variations.

Realizing this disadvantage, Mr Edward Weston has recently brought out an important addition to his well known and admirable instruments consisting in a temperature regulator, but which is, of course, applicable to instruments wound with whatever kind of wire.

In order that variations in temperature may be recognized, Mr. Weston provides a thermometer m, the mercury bulb of which is elongated, and is curved and fastened directly against the exterior of the coil. The thermom-



Weston's Instrument Temperature Regulator.

eter-tube is bent, as shown, and arranged upon the scale-plate and in a curve parallel to that of the scale-markings. By means of this thermometer the temperature of the coil is shown upon the same scale-plate as the regular indications of the instrument.

A series of contacts o to o^{14}, insulated from one another, are arranged in a circle, and between the successive contact-plates are included resistance-coils p^1, p^2, p^3, etc. Pivoted concentrically with the circle of contact-plates is a switch-arm q, having contact-springs bearing upon the surface of the contact-plates o.

This device is interposed in the circuit of the fixed coil, and is connected to it by the wires s t. The contact-plates o o', etc., are marked to correspond to the thermometer-scale. Thus the contact-plate o is marked "30" to correspond to the 30° mark of the thermometer, the contact-plate o' corresponds to the 35° mark of the thermometer, and so on, the contact-plate o^{14} corresponding to the 100° mark. When the arm q is placed on the contact-plate o, it will be evident that the current in the instrument then passes through all the resistances p, p^1, p^2, and p^3.

Suppose, for instance, that this is the starting point of

temperatures, and that the heat of the coil increases so that the thermometer shows a temperature of 65°. This means an increase of resistance in the coil due to the 65° difference of temperature. In order to compensate for this the switch-arm q is moved around until its contact-spring rests on the plate o^7, marked "65." Seven resistances p p' will thus be thrown out of the circuit, and as each resistance corresponds to the increase of resistance in the coil due to the elevation of 5° of temperature, it follows that by throwing out seven of these resistances we have exactly compensated for the increased resistance of the coil due to its increased heat.

In practical operation, therefore, it is simply necessary to note the indication of the thermometer and place the arm q on the contact-plate mark corresponding to that indication, in order to keep the resistance of the circuit in the instrument uniform.

THE WORK AND RESPONSIBILITIES OF THE "LOCAL ELECTRICIAN."

BY T. C. MARTIN.

TURNING over the pages of a well-known architectural journal the other day, my eye caught the remark: "Electric bells, in the architect's opinion, generally, are an unmitigated nuisance, because, possibly, their battery connections are so poorly wired, and in this case, as in others, his judgment is formed from results, not indications of what might be done if there were no *if* in sight." One can readily find food for reflection in such a cold-blooded criticism as that of ordinary electrical work; and it becomes impossible, in fact, not to recognize the truth that the "local electrician," by whom so much of the electrical bell-hanging is done, is a very important element in the electrical economy.

Uncertainty and anxiety with regard to the operation of such common appliances as electric bells, tnan which nothing should be more sure and regular in operation, or more easily maintained in efficiency, lead to distrustfulness respecting other apparatus of an electrical nature. It is not likely that a householder whose cheaply set up bells have given out on an average once a week will be very suddenly convinced of the reliability of the incandescent light. Reasoning from known to unknown, he is apt to think that one is as bad as the other. Nor is he likely to be very sympathetic and enthusiastic when invited to co-operate in the establishment of an electric railway. Evidently, the "local electrician" can make or mar other fortunes as well as his own.

The opportunities that present themselves to the local electrician are not to be despised. On the contrary, they have become such as should tempt anyone to make the most of them by winning first a reputation for good work, and then devoting his energies to getting in all the installations he can. The wonder is that more of the young men who leave our schools and colleges every year well grounded in electrical theory and practice do not take up the local supply business as a means of honorable livelihood. Every town or city of fair size offers chances of this kind, and large general supply houses are now so numerous, so well stocked and so handy that goods can be obtained in a day, unless special devices are required.

It is true that in many instances the local electrical business has been skillfully worked up, but, on the whole, it is the merest beginning of what it might be. I have been living in New York and Brooklyn for nearly fourteen years. During the whole of that time, although dwelling in populous neighborhoods, where trade could be easily drummed up, I have never once had the circular of a local electrician left at my house. In New York, where I now live, the avenues nearby show the signs of more than one "electrician, bell-hanger, and lockfitter," yet never have those worthies favored me with a polite request to be allowed to do a little electrical work for me. Some of them are excellent people, busy all the time on new residences and apartment houses. Others, when I have visited their stores, have handed me out sal ammoniac of the consistency of granite, or if asked for a bell showed one with binding posts gone.

The house I live in was wired in a very perfunctory manner, with the result that some of the circuits I have not yet been able to coax up to the working point. The batteries were installed on a small shelf in the cellar right under the floor beams and in the dark. The shelf is immediately in front of the winter furnace, so that the rate of evaporation of the electrolyte between October and May is about the highest that could be attained. Of course I have remedied this state of things to some extent, but no one cares to plunge heavily into rewiring a whole house that doesn't belong to him. A few "interior conduits" at the outset would have been a perfect boon, and the wonder is that any new house is built without them. I know that the state of affairs I describe is not exceptional, since, like most people reputed to be interested in electricity, I am now and then invited by neighborly folk to look in and tell them what is the matter with their bells.

The average resident in a city is too busy to bother with his bells, and often too pushed for time to go even half-a-dozen blocks out of his way for the local electrician. Hence, the bells, once out of order, often stay so for two or three days to the exasperation and confusion of every body concerned, whether occupants of the house or callers there. Now, could not the local electrician undertake for a small fixed sum, per month, or quarterly, to keep bells, batteries and circuits in order, calling to make necessary repairs and renewals? I believe such a service, diligently and honestly rendered, could be made to pay handsomely. There are many doctors, too, ready to pay a good round sum for having their medical batteries kept up to efficiency.

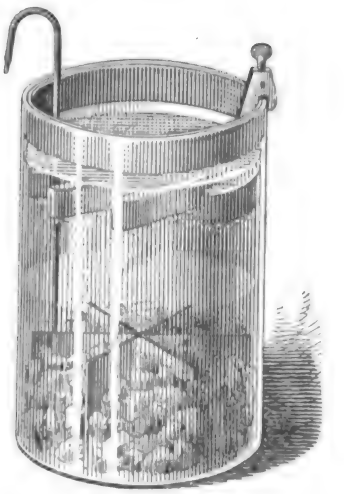
Every week sees the announcement of some ingenious electrical novelty for the house or office, and the big supply houses vie with each other in bringing out these goods attractively, at moderate cost. Yet, how few of them reach the would-be user and consumer of them! During the past summer, I often heard people ejaculate the wish that they could have in their houses the cooling little electric fans that mitigated the heat down town. All that was necessary was the canvassing of the residential districts, the installation on trial for a few days—and then the certain sale. In the case of primary batteries for current, there would at once be a market for renewals.

As with fans, so with motors for sewing machines, annunciators, floor and table pushes, burglar alarms, electric clocks, electric time and date stamps, small incandescent lamps for special decorative effects, and a dozen other appliances. If people do not know of these things, they do not call for them, though they may want them. If attention is directed to them, some will be sold at once, to serve in turn as an advertisement, creating a demand for more.

It is no exaggeration to say that if this local business were exploited to its fullest degree in each community, the stimulus to electrical industries would be as great as that from the development of electric lighting or electric railways. I look forward to the day when more will be made of such opportunities than is the case now. But the advance must evidently begin with better work, so that electric bells may cease to be an "unmitigated nuisance" to the architect, who is already showing himself so willing to employ electrical devices and appliances if trustworthy. Life is too short, anyway, for poor work, and if an electrician's prosperity depends, as it must largely, on the esteem in which his installations are held, it is the worst folly to use rotten material, scamp a job, and then ask a low price because it has been cheaply done. The public is ready to pay a fair price for electrical work when assured of honest material and skilled workmanship; and it will be the readier to believe in electrical engineering as a profession when its front door bell rings regularly.

THE DELANY BATTERY STRIP FOR PREVENTION OF "CREEPING."

One of the inconveniences which has attended the use of many forms of battery, especially those of the gravity and Leclanché type, is the creeping of the salts, and many devices have been applied to overcome the difficulty, but thus far with comparatively little effect. We are, therefore, glad to note the success of a very simple expedient for the prevention of this evil, due to the well known inventor, Mr. P. B. Delany, of South Orange, N. J. For this purpose Mr. Delany applies to the top of the cell, on the inside, a strip of rubber cloth, as shown in the accompanying engraving. The rubber offers a mechanical obstruction to the creeping salt, which accumulates underneath the strip,



Delany Battery Strip to Prevent Creeping.

and is re-dissolved in the battery fluid whenever water is added to make up for that lost by evaporation.

As creeping of salts is a fruitful source of local action and waste in batteries, the application of the strip affords a distinct gain. Besides, owing to the cleanliness obtained, batteries can be placed in wardrobes, closets or even on carpets, with perfect safety.

It is over a year ago that Mr. Delany first showed us this simple appliance, but he has thought it well to give it a thorough trial before offering it as a practical method. The results of a year's test have been such, that its value is now thoroughly established, and hence its commercial introduction.

RAWSON'S METHOD OF IMPREGNATING INSULATING PARTS.

In a patent recently issued to Mr. Frederick L. Rawson, of London, the inventor describes a new method of preparing a compound to be used for the bases of electrical instruments, casing or conduits for conductors, and generally those parts of electrical apparatus or machinery where insulation is required.

For this purpose there are first intimately mixed about six parts, by measure, of Portland cement with one part of plaster-of-plaster, and with sufficient water to convert the mixture into a paste suitable for molding under addition of a proportion of clean sand. This paste is molded to the form desired, coring in it such holes as may be necessary for bolts or other attachments, and molding in it such metal parts as may have to be permanently attached to it. After the material has set in the mold it is removed and dried slowly at a moderate temperature during ten days or more, the time depending on the mass that has to be dried and the degree of hardness required. The molded article may be further hardened by immersing it for a day or more in a solution consisting of equal parts of silicate of soda or potassium and water.

When the molded article is sufficiently dry and hard, it is heated to about 105° or 110° Centigrade and then submerged in a bath of molten ozokerite or paraffine-wax. When the molten material has cooled down to about 95° centigrade, the molded article is removed from the bath and cleared of the superfluous matter adhering to it.

In making boxes or tanks which cannot be conveniently immersed in a bath of the impregnating material, Mr. Rawson provides a closed metal vessel that can be put inside the molded article, leaving a space all around it to receive the impregnating material. This vessel is charged with steam at a temperature of 105° to 110° centigrade, so that the material is kept in a liquid condition as it soaks through the thickness of the box or tank. The article thus impregnated with the oily matter is hard, strong, tough, and incombustible and has high electrical resistance, so that it forms a good insulator, and being protected against access of moisture, it permanently retains its insulating properties.

JEANCON'S PROCESS OF ELECTRO-DEPOSITING ALUMINUM.

The valuable properties possessed by aluminum—coupled with the fact that it can now be obtained in a pure state at a greatly reduced cost—make it appear as probable that this metal may be largely employed as a protecting coating for others upon which it is deposited.

Considerable difficulty has, however, been experienced in the past in depositing aluminum electrolytically, and according to Mr. John A. Jeançon, of Newport, Ky., this is largely due to the readiness with which aluminum in a state of fine subdivision decomposes water, forming a hydrated oxide in the deposit and preventing the deposition of a sufficiently heavy layer for practical uses. This oxidation readily occurs even at a temperature of 100° Fahrenheit, and prevents further deposition of metal, either from the anode or from the electrolyte.

To avoid this action, Mr. Jeançon employs a saturated solution of persulphate of aluminum, that is to say, an acid sulphate of aluminum requiring a high temperature (about 180° to 200° Fahrenheit), to prevent crystallization. This high temperature is important not only in preserving the condition of supersaturation of the solution, but also in facilitating the dissolution of the molecules of the salt in the performance of the electrolytic work of the current, which in this case is of very low intensity, but of great quantity.

The anode is a plate composed of commercial aluminum having incorporated with it a separating substance affected neither by the current nor by the solution. This is prepared by melting the aluminum in a crucible and stirring in about thirty per cent. of carbon or some other substance inert in the sense above indicated. Mr. Jeançon finds carbon to be preferable, and the union, which is probably largely mechanical, is facilitated by the presence of a small quantity of hydro-carbon. The aluminum takes up an indeterminate quantity, and while agitated the mass is run out into flat molds and congealed.

The composition of the anode, according to Mr. Jeançon, modifies the action, probably, in several particulars: First, the uniform separation of the metallic molecules tends to distribute the current over the entire surface, thereby breaking up the electrolytic action into a vast number of lines of force of reduced intensity diffused throughout a wide area in relation to the cathode, while at the same time polarization is prevented; second, the separation of the metallic molecules of the anode increases by porosity the metal surface exposed to the dissolving action of the electrolyte without unduly enlarging the given field of conduction through the liquid to the cathode, thus facilitating the union of the freed oxygen with the anode molecules and in a manner protecting the deposited metal.

The process described is claimed to give a dense reguline deposit of aluminum.

THE WORKING OF AN ELECTROLYTIC COPPER REFINERY.[1]

BY DR. G. GORE, F. R. S.

THE entire economy of working depends essentially upon cheapness of motive power and minimum investment of capital, and nearly every attempt to improve the process, in the direction of such economy, involves a choice between two evils. For instance, if we try to save horse-power by enlarging the electrodes and adding to the number and size of vats in series, we rapidly increase the loss of interest upon capital expended in stock of copper, solution, plant, working space, etc. If we increase the density of current with the intention of working more rapidly with the same stock of copper, solution, etc., we increase the loss of energy by causing polarization, and run a risk of depositing impure copper. And if we attempt to diminish the resistance by placing the electrodes nearer together, or by quickly stirring the solution, we get dirt upon the cathodes, or short-circuiting occurs; and if we endeavor to decrease it by considerably heating the liquid, we rapidly increase the chemical corrosion of the deposited metal, and quickly alter the chemical composition of the liquid; or if we diminish resistance by large additions of acid, we promote chemical corrosion, polarization, and separation of gases.

Difference of potential required is a large element in the economical deposition of copper. Whilst the same number of amperes of current passing through the ordinary solution deposits the same amount of copper in all cases, the necessary degree of difference of potential to overcome resistance, etc., varies in different cases; and the greater this difference the larger the cost; double the potential requires double the motive power. It is desirable, therefore, to lower the difference of potential as much as possible by diminishing the resistance throughout the circuit, and by avoiding all polarization and counter electromotive force.

The degree of electromotive force required varies with every different kind of solution, and consequently of anode. It varies according as the anode is composed of pure copper, "black copper," or "copper matte," and whether the anode is clean, or covered with an adhesive badly-conducting coating; it is also much greater when gas is evolved at either electrode.

Influence of Impure Anodes upon the Liquid.—I will only speak of some of those substances which are more or less likely to be present in "black copper," "pimple copper," "Chili bars," "blister copper," containing from 89 to 98 per cent. of copper, and in cruder regulus of reduced pyrites of iron and copper. Those impurities include antimony, arsenic, bismuth, cadmium, carbon, cobalt, gold, iron, lead, manganese, platinum, silver, tin, zinc, suboxide of copper, sulphides of iron, copper, and silver in the particles of unreduced pyrites of those metals, alumina, lime, magnesia, silica, and alkalies in the enclosed portions of slag. Black copper has been found to contain "1.28 per cent. of arsenic, 1.0 of iron, .54 of sulphur, .4 silver, and .011 of gold." (*Engineering*, 1885, p. 306.)

In an acidulated solution of blue vitriol, the following of those substances, viz., cadmium, cobalt, iron, zinc, sulphide of iron, alumina, magnesia, and alkalies of the slag, dissolve readily; antimony, arsenic, bismuth, tin, and silica dissolve imperfectly, and partly fall to the bottom; carbon, gold, platinum and sulphur from the pyrites are insoluble, and precipitate entirely; lead is converted into sulphate, which almost wholly precipitates; silver is changed into chloride, provided a soluble chloride is present, which is usually the case, and is entirely thrown down; suboxide of copper, and the sulphides of copper and of silver, also precipitate. The lime is all changed into sulphate, a small quantity only of which enters into solution, whilst the remainder subsides.

One effect of using an impure metal or an alloy as an anode is, that its different constituents are corroded unequally, both by the ordinary chemical action of the liquid and by the influence of the current. By both these actions the most electro-positive metals are attacked first, and the others in succession, in accordance with the thermal law which governs such actions; and those which are not corroded at all, together with those which form insoluble compounds, either remain upon the surface as a coating, or fall to the bottom as mud.

In an anode containing copper, copper oxides and sulphides, the current goes most by the path of least resistance, *i. e.*, very largely by the metal, very little by the sulphides, and much less by the oxides. If, therefore, the anode contains very little sulphide or oxide, the whole of the current travels through the copper, and the oxide and sulphide fall to the bottom; but if it contains much sulphide, some of the current passes through it. At the same time, independently of the action of the current, the liquid is always acting chemically upon each of these substances, whether they form part of the anode or of the sediment.

It is evident that when the anode contains a large variety of impurities the chemical actions going on at its surface must be numerous and exceedingly complex, and modify each other, and make it very difficult to accurately describe them. One effect of those numerous impurities is to cause an almost infinite number of local electric currents all over the anode, attended by corrosion and solution of all the more positive substances without the aid of the external current, thus gradually neutralizing the free acid, and saturating the water with metallic salts.

Influence of the Impurities upon the Current.—Provided the anodes are wholly metallic, their lower degree of electric conductivity due to impurities has very little effect upon the total resistance of the circuit, because the resistance of the solution is so very much greater. Consequently, also, it has but little effect upon the kind of dynamo required.

Impurities in the anode, however, have in some cases a great effect upon the electromotive force and upon the strength of current, either by giving rise to polarization and counter electromotive force, or by the formation or accumulation of badly-conducting substances upon the anode. The greater the number of impurities also the greater the risk of waste of energy.

It is a fact that the electromotive force, and consequently also the strength of current, is increased when the anodes contain as impurities metals such as zinc, cadmium, manganese, or iron, which are more electro-positive than copper in the particular liquid, because they constitute with the copper cathode a voltaic couple sending a current in the same direction as the working one. But this assistance to the current, except with iron pyrites, is usually so very small that it is hardly observable, and the advantage of it is more than counterbalanced by disadvantages. The presence of iron in the anode aids the current to only a small extent, but that of zinc helps it more.

When the solution contains persalts of iron or manganese those salts are reduced to proto salts at the cathode, and a portion of the current is continually wasted in reducing them, instead of being wholly employed in separating copper, and the copper costs more to refine than when no iron or manganese is present. As long as there is sufficient persalt of iron in the liquid, no hydrogen is evolved at the cathode. With a copper-depositing solution containing much salt of iron, the difference of potential of plates of pure copper of a single vat has been found by experiment to be .22 volt, with an anode of black copper .25 volt, and with one of copper pyrites .5 volt, and when the solution was deficient in free acid, it was .35 volt with black copper, and .75 volt with copper pyrites. (Kiliani, *Engineering*, Vol. XL., 1885, p. 306.)

Effect of Impurities of the Liquid upon Purity of the Deposit.—The electrolyte is always less impure than the anode, because various of the impurities of the latter are either loosened by corrosion of the surrounding metal, and separate and fall to the bottom unchanged; or they are separated from their compounds by chemical or electro-chemical decomposition and subside; or they are converted by chemical action into insoluble compounds, which precipitate.

During the process of deposition the electrolyte continually becomes more impregnated with impurities, especially with iron, and, in much less degrees, also with zinc, manganese, cobalt, nickel, tin, arsenic, antimony, bismuth, aluminum, calcium (within small limits), magnesium, potassium, and sodium, and gradually poorer in free acid, and sooner or later, requires to be purified.

Influence of Impurities of the Liquid upon the Current.—The greater the number of impurities in the electrolyte the greater the risk of waste of electric energy. All ordinary sulphate of copper solution used in the electrolytic refining of copper contains, after a time, forms a greater or less proportion of dissolved ferrous sulphate, and this substance gradually combines with the oxygen of the air and becomes persalt. In such a mixture there is liable to occur a considerable waste of current and deficiency of deposited copper—1st, because much of the electric energy is wasted in deoxidizing the persalt at the cathode; and 2nd, because a solution of persalt of iron corrodes and dissolves copper; the free acid therefore decreases, and the liquid acquires greater specific gravity. The presence of green vitriol, however, prevents polarization at the anode, because it absorbs oxygen.

Purity of the Deposited Copper.—It is a mistake to suppose that electro-deposited copper must be pure; if it has been deposited rapidly from an impure solution it may be very impure.

Of all the various circumstances already described which tend to produce purity of the copper, the most important are:—1, Absence *in solution* of all the metals which are the most readily deposited with it: these are silver, bismuth, antimony, arsenic, and tin; 2, using a sufficiently moderate density of current at the cathode; 3, keeping the solution perfectly clear and well circulated; and 4, not allowing any of the mud from the anode to touch the cathodes. All other conditions being alike, the most slowly deposited metal is the most pure.

There is usually not much risk of depositing any other metal than copper (and silver or bismuth if in solution) under the ordinary conditions of working when the density of current does not exceed 5 amperes per square foot, or the rate of deposition is not more than 70.7 grains per square foot per hour, and the increase of thickness is not greater than 1.07 millimetres, or .04 of an inch per week of 156 hours. At Stolberg, with an impure solution, and a density of current of 1.482 ampere per square foot, the purity of the deposited copper is stated to be "99.92 and 99.95 per cent. in two analyses." One source of impurity is fine powder from the anodes diffused in the liquid.

1. Abstract from *The Electrician*.

Cost of Electrolytic Refining.—The cost of refining copper by electrolysis varies with the magnitude of the installation, and depends essentially upon the expense of motive-power, and of interest upon invested capital; also largely upon the degree of "commercial efficiency" of the dynamo, and upon the kind and amount of impurities in the crude metal, which are continually varying, because the composition of each batch of unrefined copper differs. The larger the proportion of foreign metals which are easily deposited with the copper, and the purer the refined copper required, the greater the cost of the process, because it must be conducted more slowly. The cost when anodes composed of the unreduced sulphides of copper and iron are employed instead of metallic copper, as in "Marchese's process," is considerably different.

Where motive-power or fuel is cheap, advantage is taken of the circumstance to economise the expenditure upon vats and copper, by using it more freely. At Casarza, where water-power is cheap, the proportion of copper deposited is 1.4 lb. per horse-power per hour; at Pembrey, where coal is cheap, it is 2.6 lb.; but at Hamburg, where motive-power and fuel are dear, it is 6.87 lb. The amount of electric energy and of horse-power consumed in depositing the same weight of copper differs in nearly every electrolytic refinery. Where coal is cheap, and the process is conducted on a large scale, with a good steam engine, at least 110 indicated horse-power is obtained during one week by the consumption of 50 tons of coal, and with good dynamos will deposit 20 tons of copper per week, at a cost of £20. The interest upon capital invested in plant, etc., during the same period will amount to about a similar sum. Or, if we reckon the cost of one mechanical horse-power at one penny per hour, the cost of such power for electrolytic refining of copper is about one farthing per pound of that metal refined. Difference of potential required to overcome resistance and polarization is also an element in calculating the cost of depositing a given amount of copper, because double the electromotive force expended costs quite double the money.

The chief elements of cost are:—1. Interest upon capital expended upon copper, electrolyte, vats, steam-engine, boiler, dynamo, and other plant. 2. Fuel, water, and oil for the engine. 3. Rent and taxes. 4. Labor. 5. Depreciation of steam-engine, boiler, dynamos, vats, etc. 6. Incidental expenses.

The total stock of copper required in order to refine a given amount of that metal per day or week varies in different works. In each refinery, besides the amount of copper in the vats, there is at least an equal quantity in the form of main conductors, raw copper for making anodes, new anodes ready for immersion, and residues of old anodes, also the stock of refined copper. The value of the stock of copper alone in one of the installations at Hamburg has been estimated at "£8,000." Practically, to refine 30 tons a week of ordinary "Chili bars," with a current density of 8 or 10 amperes per square foot, requires a total stock of about 400 tons of copper, which, at £50 a ton, costs £20,000, to which we must add about £10,000 for plant and premises.

A number of workmen are necessary, probably about twenty, working day and night, when depositing thirty tons of copper per week, to manipulate the electrodes, examine the vats, and attend to the steam-engine and dynamo, melt and cast anodes, wash dirty ones, etc. A chemical analyst is also employed to analyze the copper and the electrolyte. As stoppages in the process do not often occur, they are not a large element of expense; there is, however, the cost of occasionally emptying the vats, evaporating and purifying the solution, collecting and treating the mud, etc.

In consequence of the numerous circumstances which affect the cost, an approximately satisfactory estimate of the total amount of capital required to be invested in establishing an electrolytic refinery to deposit a given amount of copper daily, can only be arrived at by means of a knowledge of all the essential particulars in the given case.

Recapitulation.—In establishing an electrolytic copper refinery, the chief points usually require to be settled in the following order:—1st. The amount of copper to be deposited per week. 2nd. Amount of mechanical power required and the kind of motor. 3rd. Degree of purity of the solution and of the crude metal. 4th. Rate of deposition per square foot of cathode surface per week. 5th. Total amount of cathode surface necessary. 6th. Total number of vats in series. 7th. Magnitude of each vat. 8th. Electromotive force and strength of current necessary. 9th. Kind of dynamo. 10th. Magnitude of the main conductors. There are, of course, other important points to be first considered, such as the most suitable locality for cheap motive-power, cheap conveyance, etc., but those do not come within the intended scope of this article.

THE FORT WAYNE ELECTRIC CO. have just sold a 75 light arc machine to the Marion Electric Light Company, of Marion, Ind. Mr. W. J. Buckley, Western manager of the company, has recently sold a 1,200 light alternating current machine to the electric light company in Streator, Ill.

TESLA'S NEW ALTERNATING MOTORS.

REPLYING to the exceptions taken by Mr. N. Tesla[1] to the criticisms of *Industries* on some of his more recent designs of alternating motors that journal has the following in a recent issue:

The main difference of opinion, we think, lies in a nut-shell. Mr. Tesla holds that if an increasing excitation is applied to an iron core it affects the outside first, and the lines of induction, or lines of force, accumulate in the outside till the iron becomes more or less saturated, and then penetrate to the inside. The outside thus magnetically screens the inside. If the core is laminated, so that there are no Foucault currents, this cannot occur. The line integral of the magnetic force taken round any circuit interlinked with the magnetizing coils is $4 \pi n C$, where n is the number of turns and C the current in C. G. S. This interlinked circuit may be taken through the centre of the core or near the outside, and has the same value in each case. This value is independent of the time. If the iron is not laminated, Foucault currents will be generated in a direction opposed to the primary electromotive force, and these will introduce a time lag. At any instant the integral of magnetic force round a circuit passing along the outside of the core is still $4 \pi n C$, but along any circuit cutting the iron it is $4 \pi n C + 4 \pi n^1 C^1$, where C^1 is the surface integral of the Foucault current interlinked with the circuit in question, C and C^1 having positive or negative values according to their direction. As C^1 depends on the time rate of change of C there is thus a time lag. For instance, if a current is suddenly turned on a solid cored electromagnet, currents in the opposite direction circulate in the iron, so that at first they partly demagnetize the centre. They die away gradually, and the centre is then magnetized as fully as the outside. The lag is here produced entirely electrically, not by any sort of magnetic screening. Mr. Tesla develops his magnetic screening in this way. He wants to get a set of poles on a motor to lag behind another set. He therefore excites the leading poles with an alternating current in the usual way. The lagging poles have their cores wound with iron wire first. The iron wire is not wound parallel to the induction in the core, but at right angles to it, and is referred to as a closed magnetic circuit. Why is not clear, for it is not interlinked with any exciting circuit whatever. Outside this is wound the exciting coils proper. Mr. Tesla thinks this coil of iron wire screens magnetically. We think it acts as a secondary electric circuit. It gets slightly magnetized also, but the direction of magnetization is at right angles to the wire at every point, not round what Mr. Tesla calls a closed magnetic circuit.

Mr. Tesla also described a transformer. In this a ring of iron wire is taken as core, as usual. It is wound with secondary, also as usual. The secondary is then coated with iron wire. Apparently we were in error when, in our previous note, we said this shield was laminated in the wrong direction; the lamination in the wrong direction—that is, not parallel to the induction—is in the motor, and, from the description, one at least of the transformers has its "screen" laminated in the right direction. Over this "screen" is wound the primary. Mr. Tesla thinks this intermediate layer of iron acts as a magnetic screen. If it is laminated in the right direction, so as to have no Foucault currents, the induction at any instant in the inner core is $(4 \pi n C + 4 \pi n^1 C^1) \mu/l$, where n^1 and C^1 are the secondary turns and current, and l the length of the core circuit. The induction in the outer "screen" is $4 \pi n C \mu/l$, and there is no time lag. The effect of such an arrangement is that the primary coil is interlinked with more iron than the secondary, so the effect is just the same as putting a choking coil in series with the primary of on ordinary transformer. Mr. Tesla says triumphantly we are wrong, for it does screen; we say that he has misinterpreted his results.

COLLEGE NOTES.

EXPERIMENTAL APPARATUS FOR CORNELL UNIVERSITY.

In circular recently issued, Prof. R. H. Thurston, director of Sibley College, Cornell University, calls for plans and estimates for an "Experimental Steam Engine," such as is customarily made a part of the equipment of technical schools of the higher class, and used by them in researches in steam engineering. Cornell already has a number of engines adapted, in various ways, for this work; but it is desired that one should be here installed which shall present peculiar facilities for illustration, and for investigations in connection with the higher graduate courses of instruction, and in the schools of steam engineering, of marine engineering and naval architecture, now making preparation for their work, and in the school of railway mechanical engineering, which it is anticipated may be organized, should the former prove useful and successful.

The circular gives full specifications of the type and construction desired.

Proposals are also invited for a testing machine having a capacity of not less than 200,000 lbs., and intended for the Mechanical Laboratory.

1. THE ELEC. ENGR., Sept. 24, p. 344.

LITERATURE.

Electricity in Daily Life. A Popular Account of the Applications of Electricity to Every-day Use. By C. F. Brackett, F. L. Pope, Jos. Wetzler, H. Morton, C. L. Buckingham, H. L. Webb, W. S. Hughes, John Millis, A. E. Kennelly, and M. A. Starr. 125 illustrations. 288 pages. Cloth. New York: *Charles Scribner's Sons*, 1890. Price, $3.

ENCOURAGED by the great success attending their series of Railway articles, afterwards reprinted in book form, and constituting a most valuable work of reference, the managers of *Scribner's Magazine*, during the past eighteen months, have been publishing in that periodical a series of articles on electricity. In the present volume these electrical articles are gathered together, making a most interesting, valuable and handsome contribution to the literature of the subject.

A great peril—and more than one perhaps—awaits the writer of articles intended to convey to a public, of general culture, but uninitiated in the technicalities of any special science or industry, a clear, fair idea of what has been done and what the leaders in that field are aiming at. The peril is that of being so technical that half the information remains a dead letter, or else of falling into so juvenile a method of treatment that the reader's stomach is apt to revolt at the mess of sweet pap, as fit only for infants in knowledge. It is not given to everybody to act as a popular interpreter of the higher mysteries of science and art. The talents required for being in sympathy with the technical classes, and yet of fully understanding what the unscientific masses need, are rarer than the profusion of "popular science" efforts would indicate. In a series of this kind, under the skillful direction that one expects from a standard magazine, the slips to one side or the other of the happy mean should be few; and on the whole, one's expectations are gratified. Prof. Brackett's introductory article is probably that which makes most demands on the public, and seems at first too abstruse; yet, a second and third perusal renders it hard to say wherein it is not just what is wanted as a helpful exposition of the leading principles embraced in the science. A few similes and analogies might have helped it, but they are pitfalls for the unwary very often, and, besides, it is a magazine article of scant limits that we are discussing. It might also be objected to Prof. Morton's paper on electric lighting that the copious citation of patent references and dates is a mistake, since it leads nowhither so far as an untutored public could see. But, even allowing that there may be a little in it over the heads of the public, the book is sure to amuse, enlighten and instruct all who turn to its pages for information on what is unquestionably the most fascinating subject in physics to-day.

There are only two topics that we would particularly have cared to see added to the list treated of in this book, although many others might be suggested. The two are telephony and electro-metallurgy. In one sense the telephone is a telegraph, but since Mr. Buckingham's excellent article on telegraphy lets telephony alone, we do think some such expert as Mr. T. D. Lockwood or Prof. Cross should have been invited to describe that great department of work. So, too, in metallurgy, the range of electrical application is so enormous that it is hard to see why it should be unnoticed, while electricity in medicine, a specialty of less range, receives, at Dr. Starr's hands, a very creditable summarizing.

To a certain extent, the chapters group themselves. Thus Mr. F. L. Pope's and Mr. Joseph Wetzler's articles on electric motors and electric railways should be read together, and they will be found to sum up admirably the results and tendencies in the vast field of electric power. The statements made as to the development of electricity in electric traction are most stimulating, and the story of the evolution of the electric locomotive shows in many respects a close parallel to that of the steam locomotive. It is true that both gentlemen deal largely in forecasts and promises, but even since they wrote their "long distance" predictions, events have hastened to justify them. And then there is always more interest in the things men are going to do than in the humdrum things they do now as a mere matter of course. The present generation is a little bit tired of hearing its progenitors boast of being "the first to ride in the steam cars from Albany to Schenectady," and desires for itself the satisfaction of being the "first to ride in the electric cars from New York to Philadelphia." Yet even that, we note, will be a commonplace ten years hence.

Dr. Morton's paper on electric lighting serves as a link between these two and those which succeed, on the land telegraph and the submarine cable, just as the electric light itself linked the old electric dispensation of small currents and minute apparatus with the present time when the electrical engineer talks in units of 10,000 electrical h. p., and throws nightly into his circuits, in a single city, more electrical energy than would run the largest telephone office for a century. Due emphasis is laid by him on the fact that the improvement in arc and incandescent lamps came with the perfection of the dynamo; and these two elements together creating the modern central station reacted on the antiquated, primeval electric motor and perfected that.

As becomes an officer of the Western Union Co., Mr. Buckingham begins with a graceful tribute to Prof. Morse, but as an officer of that company, he should certainly have buried in deep obscurity, rather than have paraded it, that hideous, horrible tangle of wires shown as the underside of the big switchboard at "195." We have seen many messes of wire but none quite so bad as that, and, as it stands, the picture is a thorough and satisfactory explanation of the late great fire. We think there must be some mistake about that nightmare; it is so unlike the ideas of order and system necessary in a huge electrical establishment, and such as we know Mr. A. S. Brown to be an ardent advocate of. Perhaps if Mr. Brown had had his way, the tangle would have been wiped out of existence long before the fire saved the company the trouble.

A fitting adjunct to the telegraph paper is that on the making and laying of a submarine cable by Mr. Herbert Laws Webb, but it stands quite by itself in merit, as being the most genuine literary production of the lot. It is a really clever piece of work, for though one is simply made a *compagnon de voyage* in a cable expedition and not expected to assist, the feeling throughout is of actual, anxious participation in all the exciting incidents and vicissitudes, and of enthusiastic triumph when the work is done and De Sauty is once more vindicated.

Next come the papers on electricity in naval and land warfare by Lieuts. Hughes and Millis. It is clear to see that not only have we a new navy but that it is fought in a new way, much to the bewilderment and annoyance, we imagine, of the old school, which does not care to go into action with a telephone on its ear, its finger on a telegraph key and an electric range finder at its elbow. So, too, on land. Lieut. Millis makes it evident that electricity must play a big part in the next great war. Bismarck disliked the telegraph because it prevented diplomacy from being unctuous. As his diplomacy never ran much that way, we doubt the sincerity of this remark, but we do know that in the German military tactics of Von Moltke, as in every other advanced army studies, the determination to get rid of the unctuous and slow in warfare by pressing electricity to its very extreme of performance is more and more apparent. As an antidote to these two bellicose papers, the reader may, however, next take up Dr. Starr's and learn how powerful an agent electricity is for saving life and restoring health, as well as for malthusian ends.

Mr. Kennelly has a subject we should hardly have assigned to him, as he is a pastmaster of the laboratory and has not bothered greatly with push buttons and burglar alarms, but he acquits himself most excellently well, and his little diagram showing how the electric current tapped from the street main can be put to an endless variety of lighting, heating, driving and signaling purposes, is a revelation in itself. One wonders in looking at it how soon we may all be able to realize it, and thus escape from the dire misery and slavery to which European domestics now subject innocent American households. God speed the day! In the meantime it is to be hoped that the energy and enterprise of the electrical supply trade will do more than in the past to render these conveniences familiar in our homes and offices.

This book will not make any man an electrical engineer, but it is the best extant intended to inform the public soberly yet interestingly what there is in electricity and what may be expected of it. It deserves the widest circulation, especially among those who, while not electrical, have electrical interests. Directly and indirectly that includes pretty well every American citizen. The book is beautifully illustrated, clearly printed, and has a cover of special and characteristic design, appealing to every telegraphist who has watched the mirror or siphon, listened at the sounder or pounded holes into a Wheatstone tape.

LETTERS TO THE EDITOR.

THE NEW THOMSON DYNAMO.

[146].—I have recently noted with much interest the account in your paper of Elihu Thomson's new dynamo, but am somewhat astonished at the apparent implication made as to the newness of type, no reference being made as to machines of similar type already out several months.

I enclose you outlines of several machines already patented and which have been running several years in this laboratory. One of them, driven by a 4 h. p. Otto, is supplying 20 incandescents and 2 A. C. arcs (large Westinghouse) in the gymnasium of the University of Nebraska, at Lincoln. D. B. BRACE.

Boston, Mass.

[Our correspondent encloses copies of two patents issued to him, both entitled Dynamo Electric Machine, No. 421,479, Feb. 18, 1890, and No. 427,294, May 6, 1890. While both of these machines are of interest and may be considered to be of the same general type as that of Prof. Thomson, the latter has features quite distinct from those shown in the patents referred to.—EDS. ELECTRICAL ENGINEER.]

CORRESPONDENCE.

CHICAGO.

Lighting Street Cars.—Owens' Electric Musical Instrument.—A New Motor Company.—H. A. Douglass.—Charles Wilson's Ingenious "Busy Board."

THE West Side Street Railway Company are considering the question of placing electric lights in their cars.

Dr. Owens, of Chicago, has just devised a unique musical instrument which comprises a set of chimes to be rung by electricity, and is intended to be used for advertising purposes. The instrument, it is proposed, will be conveyed through the streets on an electric tricycle, and played during the trip like an ordinary piano. An electro-magnet is attached to each of the thirty bells hung above the keyboard. The keys make the circuit from a battery in the base to the electro-magnets at the bells.

A new company has been formed for the purpose of furnishing electric lighting to that portion of South Chicago known as the East Side.

The Northwestern Electric Motor Company has just been incorporated at Chicago to manufacture and use electric motors and sell and operate the same. The incorporators are Thomas B. Bryan, Frank Weeks and M. W. Towle.

Mr. H. A. Douglass, late superintendent of the messenger department of the Chicago Telephone Company, recently resigned his position to go into other business. His late employés called at his home last week and presented him with a handsome lamp.

The "busy-board" invented by Mr. Charles Wilson, superintendent of the Chicago Telephone Company, is now in successful operation at the central exchange. The arrangement of the instrument is such that when a subscriber calls for a number which is busy the desired wire is held at the "busy-board" and given to him as soon as disengaged. In this way a long list of subscribers who want the same number can be served in turn. The instrument is so constructed as to accommodate six operators and can take care of 6,000 wires. It supplies a long-felt want, as any one who ever used a telephone knows the tedious delays caused by "busy wire." Mr. Wilson's "busy-board" is the first solution of its kind of a problem which has always troubled the telephone companies, and it gets over the difficulty in the most simple and successful manner.

CHICAGO, Nov. 14th, 1890.

BOSTON.

Work in the City Council.—Snow Plows for the West End.—Boston Electric Club.

AT a meeting of the Board of Aldermen this week the street commissioners, replying to an order of the board, stated that it would cost $1,070,000 to extend Harrison avenue to Summer street and Hawley street to Water street and the widening of Water street, in accordance with the plan proposed by the West End railroad. The communication was placed on file.

The case of the Suburban Light & Power Co. vs. the Board of Aldermen of the city of Boston was argued before the full bench of the Supreme Court yesterday.

The action is brought by the Suburban Company to compel the Board of Aldermen to grant locations for electric light poles in certain streets of the city.

The West End Street Railway Company are preparing for the coming winter and have just completed four new snow plows for taking care of the heavy snows which are liable to interfere with their traffic. These are now being tested and as soon as approved they will manufacture more until they have 25 in all. In appearance it much resembles a small freight car. Its width on bottom is 6 feet, with a length of 14 feet. The cab is 8 feet long, 6 feet wide and 7½ feet high.

There are two 15 horse-power motors inside the car. These are of the ordinary railway type. Being inside the car body, they are protected from the rain, storm and wind. The rheostat is inside the car, and at the end of the route, for instance, will be used to throw off heat, so that the men operating the plow can warm up. The gears on the motors have been dismantled, and on the armature shaft has been placed a sprocket pinion, which gears down, by sprocket chain, to a counter shaft in the centre of the body, underneath the car frame. This makes one reduction and there is another from the counter shaft to the car axle sprocket wheel. The motors will furnish a speed of from 12 to 13 miles per hour, which will enable them during the winter months, when it is snowing, to keep out of the way of the regular passenger cars. The plows are all equipped with a powerful brake which requires no turning of spindle, but simply the pressure of a man's foot. The results are instantaneous and most effective. The interior of the plow is lighted by a bunch of three incandescent lamps. On each platform over the door, there are single lamps, which furnish sufficient light to men operating the plow. The customary headlight is carried on the dasher at night.

The first dinner of the season of the Boston Electric Club was held at Young's Hotel on Monday, President Cram in the chair, who was supported on the right by Prof. Elihu Thomson, and on the left by Capt. Eugene Griffin. The dinner was an excellent one, after which Prof. Thomson delighted the members with an impromptu lecture on the properties of alternating current, freely illustrated by experiments. The experiments have all been thoroughly described in these columns before, but many of the members had never witnessed them, and they were watched with the keenest interest. After the lecture Prof. Thomson was greeted to a hearty vote of thanks. The house and entertainment committee are arranging for a monthly series of these dinners and papers throughout the winter.

BOSTON, Nov. 14, 1890.

PITTSBURGH.

New Fire Alarm Office.—Braddock Electric Railway Troubles.—Allegheny City Lighting Superintendent.—Beaver Falls Electric Railway.

THE new fire alarm office of the city of Pittsburgh is now nearly completed. The handsome mahogany cabinets for the new switch board annunciator and other instruments are already in place and the rest of the furniture is expected to arrive in the city within a few days. The walls of the office are wainscoted in mahogany and the ceiling will be handsomely frescoed and decorated.

The next thing to be done will be to put up the instruments in position and to make the connections of the wires. Superintendent Morris Mead of the City Electrical Bureau stated a few days ago that, when the work is all completed, Pittsburgh will have the finest fire alarm office of any city in the country. The best offices now are equipped with instruments at least four years old and since then there have been so many improvements made, that are all being embodied in the work here, that from an electrical point of view there is not much doubt the Pittsburgh fire alarm office will be the finest in the country.

The switchboard alone costs $9,000.

The Braddock and Turtle Creek Electric Street Railway Company yesterday filed a bill in equity in the Pittsburgh courts against the borough of Braddock. The railway people claim that they obtained a right of way for their line through Main street, Braddock. They commenced work according to the terms of the ordinance, and among other things erected poles along the street. No objection was made to the putting up of the poles except three, which they were prevented from erecting. The objection to these, it is alleged, is only because of the complaint of the owners of the abutting property. The company asks that the defendants be restrained from interfering with them or removing the poles they may put up. The case will receive a hearing some time next week, and as it is the first time such a case has been brought before the courts of Western Pennsylvania the result, whatever it is, is very anxiously looked forward to.

The Allegheny City Council Committee on Gas and Lighting met last evening for the purpose of considering the advisability to abolish the office of Superintendent of Gas and creating that of Superintendent of Public Lighting. This change has been necessitated by the establishment of an alternating current arc and incandescent light plant, which the city authorities about a year ago contracted with the Westinghouse Electric and Manufacturing Company to be erected. That plant has been in operation since last July, and all the gas lamps have now been thrown out by the city.

Beaver Falls, in this vicinity, will have an electric street railway shortly. Yesterday a charter was issued at Harrisburg, Pa., to the Central Electric Street Railway Company, of Beaver Falls, capital stock $60,000.

PITTSBURGH, Nov. 7, 1890.

WESTERN THOMSON-HOUSTON PLANTS.

The Western Isolated Lighting Department of the Thomson-Houston Electric Co. has closed contract with the Atlantic Mining Co., of Houghton, Mich., for a nine light arc plant.

H. H. Shufeldt & Co. have for some years past been using electric lights at their distillery, 23 Larabee street, Chicago, having for the purpose a dynamo capable of supplying about 125 lights. Finding that additional lights could be used to good advantage, they recently asked for bids on a much larger plant, and after very severe competition, the order was placed with the Western Isolated Lighting Department of the Thomson-Houston Electric Co. for a 400 light incandescent plant. The dynamo previously used will be discarded and an entirely new plant will be installed.

SOCIETY AND CLUB NOTES.

NEW YORK ELECTRIC CLUB.

The regular monthly meeting of The Electric Club will be held at the Club House, 17 East Twenty-second street, Thursday evening, November 20th. The address of the evening will be delivered by Prof. E. L. Nichols, of Cornell University, beginning at 8 o'clock, on "The Artificial Light of the Future." His plan is to point out the nature of certain limitations which seem to preclude hope of any very marked improvement in the efficiency of our present methods of lighting; then to discuss the properties of certain sources of light, not made use of at present, with a view to the more or less remote possibility of their development as practical illuminants. The lecture will include the presentation of some original work not yet published, together with the collation of various researches, which have not attracted general attention, taken singly, but which seem to Prof. Nichols to be significant. The results will be presented by aid of lantern slides. Members intending to be present for dinner, should notify the clerk at the Club House in advance.

ELECTRICAL DEPARTMENT, BROOKLYN INSTITUTE.

The above department is steadily maintaining its high standard of excellence. President Hamblet soon followed up his inauguration by the delivery of an admirable exposition of the electric time service of the Western Union Telegraph Co., which is maintained under his supervision. The lecture was fully illustrated. This was followed up, last Friday evening, by a lecture from Mr. H. L. Webb, on "Submarine Telegraphy." Mr. Webb has had abundant experience in that department and was able to talk interestingly on all its details, not forgetting the ever fresh and romantic story of the first Atlantic cables. He made use of the lantern to illustrate the subject and showed specimens of early cables as well as of those that had been long submerged.

THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

Mr. A. R. Foote, the secretary of the National Electric Light Association, has prepared and issued a prospectus of the Association for general circulation. It embraces the new constitution, lists of active and associate members, a statement as to the objects of the Association, and a review of the proceedings of the twelfth convention at Cape May. It is excellent campaign literature, and will, we trust, bring in many new local companies.

BOARD OF EDUCATION'S FREE LECTURES.

The Board of Education has organized a useful course of free lectures for the people to be delivered in Grammar schools Nos. 42, 83, 82, 51, 27 and 15. The lectures begin Nov. 17, and deal with practical subjects, telling people something about themselves, the work of their hands, and the world they live in. Among the speakers are Prof. C. A. Doremus, Prof. R. Grimshaw, Prof. H. A. Mott, Dr. C. S. Allen and other trustworthy specialists.

REPORTS OF COMPANIES.

WEST END STREET RAILWAY CO., BOSTON.

THE West End street railway annual report is interesting. President Whitney said the company had ordered 150 cars with 50 per cent. increased capacity, and some of them would be running in three months. From Oct. 1 to Nov. 10 travel increased 13.38 per cent. over last year; miles of road had increased 10 per cent. In three years the company would move from 30 per cent. to 50 per cent. more people, which means 175,000 to 200,000 passengers per day more than the company now carries. The plans for an elevated road already presented were the best for meeting this demand. New stock will issue for the L road $1,500,000 next year and $500,000 for the year following. Stockholders re-elected the old board and authorized elevated roads, only 872 shares voting "no." President Whitney stated, that in the new electric cars the noise from the gearing would be reduced to a minimum. He added: "Experience has shown that wherever the electric lines have been installed travel has enormously increased."

NEW ENGLAND TELEPHONE COMPANY.

The directors of the New England Telephone Company have declared a dividend of 75 cents per share, payable November 15, 1890, to stockholders of record at the close of business on October 30. The transfer book will be closed from November 1 to November 15, both days included. The report of operations for the quarter ended September 30 follows, and is noteworthy for the fact of increased expenses and construction charges:

Quarter Sept. 30.	1890.	1889.	Increase.
Receipts	$361,339	$326,181	$35,158
Expenses	261,482	225,790	35,692
Net	$99,857	$100,391	*$534
Construction	68,063	56,960	11,103
Balance	$31,794	$43,431	*$11,637
Since Jan. 1.			
Receipts	$1,042,788	$950,393	$92,395
Expenses	767,281	681,175	86,106
Net	$275,507	$269,218	$6,289
Construction	129,114	94,647	34,467
Balance	$146,393	$174,571	*$28,178

*Decrease.

ASBURY PARK, N. J.—The Asbury Park Electric Light Co. has declared a semi-annual dividend of 3 per cent.

NEWARK, N. J.—The Newark Electric Light and Power Co. has declared a quarterly dividend as usual of 1½ per cent.

ERIE TELEPHONE.—The Erie Telegraph and Telephone Co. has declared a quarterly dividend of 1 per cent.

EUROPEAN ELECTRIC WELDING CO.—The final payment of the purchase price of the European Electric Welding Company's patents for Great Britain has been postponed two months from Nov. 1, say to Jan. 1, 1891, when £40,000 is to be paid in cash, also the stock payment. The company has received £60,000 cash (not £70,000 as before stated) for the English patents, and £10,000 forfeit on the continental option. An incidental part of the new arrangement is that the English people shall pay for the machines sent over there to illustrate the principle, etc., about $16,000.

FINANCIAL MARKET.

QUOTATIONS ON ELECTRICAL STOCKS.

F. Z. Maguire & Co., Electrical Securities, of 18 Wall street, this city, report the following quotations of November 15th, from New York, Boston and Washington:

NEW YORK.

	BID.		BID.
W. U. Tel. Co	76	Edison Gen. Elec. Co	82¼
American Tele. & Cable	88	Edison Gen. Co. Pef'd	70
Centl. & So. Amer	155	Consol'd Elec. Lt. Co	...
Mexican	210	Edison Illn'g Co. N. Y.	60
Com. Cable Co	101¼	U. S. Elec. Lt. Co	....
Postal Tel. Cable	39	North Am. Phonograph	30

BOSTON.

	BID.		BID.
Thomson-Houston	39⅞	Ft. Wayne Co	*11
" Pref'd	26¼	Am. Bell	[illegible]
" Series C	11¼	Erie	*[illegible]
" " D	6	New England	[illegible]
" Int. Co	....	Mexican	[illegible]
Thomson Welding Co	180	Trop. American	[illegible]
Thomson Eu. Welding	....	Edison Phon'gph Doll	[illegible]

*Ex. Dividend.

WASHINGTON.

	BID.		BID.
Penna. Telephone	25	U. S. Elec. Lt (Wash)	140
Ches. & Pot. Telephone	66	Eck.&Sold. Home Elec. Ry.	56
Amer. Graphophone	11¼	Georgetown & Tenallytown	50

PITTSBURGH.

	BID.
Westinghouse Electric and Manufacturing Co	27⅛

AN "UNDERSTANDING" AMONG THE SWITCH MANUFACTURERS.

Various combinations and pools have been made from time to time among the manufacturers in certain lines of electrical goods, and some are in existence to-day. The switch manufacturers have now made up their minds to try this means of protection, and during the past week the "A. B. C. Exchange," 20 Cortlandt street, has been resorted to by them as a neutral meeting place. The good offices of Mr. Alexander were invoked to bring about harmonious action, whereby pendin suits were withdrawn, a price list was arranged and other business of great interest was transacted. The details are not yet ready for publication, but there is good ground for saying that as a result of the cessation of costly legal warfare, the switch buyer is likely to be benefited appreciably as well as the manufacturer.

INVENTORS' RECORD.

DIGEST OF ELECTRICAL PATENTS ISSUED NOV. 11, 1890.

Alarms and Signal :—

Combined System of Fire-Alarm and Police Patrol Telephone and Telegraph, G. C. Hale and A. Barret, 440,563. Filed Mar. 28, 1890.

Combined system of fire and police patrol telephone and telegraph, means for sending visual and audible signals to fire or police headquarters from any outlying subscribers' telephone, or from a street station, and to enable oral communication between headquarters and an outlying station; providing three distinct means of notifying headquarters of a fire or other disturbance.

Clocks :—

Electric Actuating Mechanism for Clocks, H. T. Schlegel, 440,241. Filed Sep. 6, 1889.

Automatic electro-magnetic motor driving clock train.

Electric Clock, F. Schwartz, 440,441. Filed Oct. 22, 1889.

Electro-magnets actuate pendulum directly, and indirectly actuate the train through the escapement-wheel.

Conductors, Conduits and Insulators :—

Insulating Composition, F. E. Blaisdell, 440,391. Filed May 3, 1890.

Asbestos, clay, and a flux, as feldspar and borax.

Method of Manufacturing Insulating Tubing for Electric Conducting-Wires, H. B. Cobb, 440,395. Filed April 29, 1890.

Molding upon the tubing, while soft, a continuous covering of metal, vulcanizing the soft tubing, and then stripping off the metal covering.

Distribution :—

Distribution of Electric Energy, S. Z. de Ferranti, 440,224. Filed Feb. 19, 1889.

Alternating currents and transformers; successive reductions of potential by intermediate transformers for long distances; concentric conductors.

System of Electrical Distribution, W. S. Richards, 440,326. Filed May 2, 1890.

A dynamo or other generator, two circuits and a current-director, both of which include the coils of the field magnets of the dynamo, one of said circuits also including translating devices.

Dynamo-Electric Machine, W. K. Freeman, 440,424. Filed Sept. 28, 1890.

Improved means for securing the coils upon the cores of the field magnets; specially applicable to alternating current machines.

Current-Collector for Dynamo-Electric Machines, W. K. Freeman, 440,425. Filed Sept. 20, 1890.

Applicable to alternating current machines. A metallic hub, consisting of a flanged sleeve, having a split portion or portion provided with clamping devices.

Dynamo-Electric Machine, W. K. Freeman, 440,557. Filed Sept. 20, 1890.

Design and construction to secure strength, compactness and ease of assemblage of parts; also intended to render the machine easily adjusted or shifted upon its base when mounted.

Electrical Governor, F. D. Hardy, 440,590. Filed Feb. 1, 1890.

The combination, with an electric motor, of a governor actuated by centrifugal force, a sleeve on the motor-shaft, a bell-crank lever connected thereto, and a pitman connecting the lever to the brush-holder of a dynamo.

Galvanic and Thermo-Electric Batteries :—

Battery-Zinc, Archibald J. Macdonald, 440,173. Filed Feb. 20, 1890.

Alloy of mercury ammonium and zinc added to melted zinc, finally adding magnesium.

Galvanic Battery, W. Cohlman, 440,420. Filed Jan. 20, 1890.

Design and construction for securing compactness and to permit the ready examination of any cell of a battery.

Lamps and Appurtenances :—

Arc Lamp, S. E. Nutting, 440,604. Filed March 10, 1890.

First claim as follows :—In an arc lamp, the combination of an electrode, a covering for the same of a material that disintegrates under the heat of the arc at a temperature lower than is necessary to consume the electrode, with its edge next to the arc at a distance therefrom to cause it to be disintegrated with the same degree of rapidity as the electrode is consumed, and a holder bearing against the edge of the covering next to the arc and holding the electrode from advancing until the edge of the covering is changed, consumed or destroyed.

Measurement :—

Dead-Beat Mechanism for Electrical Measuring-Instruments, E. Weston, 440,289. Filed May 12, 1890.

Retarding the movement o fan electrically-actuated body, by first establishing the actuating current and then diminishing a previously interposed frictional resistance.

Temperature-Regulator for Electrical Measuring-Instruments, E. Weston, 440,290. Filed June 25, 1890.

Means of indicating changes in temperature occurring in the instrument circuit, and, connected in said circuit a resistance and a means of varying the same comformably to the indications of the heat indicating apparatus; whereby the resistance of the whole circuit may be maintained constant.

Index-Controlling Device for Electrical Measuring-Instruments, E. Weston, 440,291. Filed June 25, 1890.

A pivoted body, means of indicating the extent of its rotary movement, and a second body moving about a centre in line with the centre of rotation of the first pivoted body, one of the bodies being provided with a projecting stop and the other having a recess in which the stop enters, thus limiting the movement of the stop.

Electric Meter, E. Mares, 440,431. Filed Feb. 26, 1890.

A balance-lever mounted to oscillate, an electro magnetic device to actuate the lever, a carriage on the lever, mechanism for reciprocating the carriage, and a registering device in the path of the carriage and separate and independent of carriage and lever.

Metal Working :—

Method of and Apparatus for Making Metallic Wheels by Electricity, W. P. Bettendorf, 440,584. Filed Sep. 11, 1890.

Adaptation of electrical welding to the joining of spokes to hubs and tires of metal wheels.

Miscellaneous :—

Electric Switch, A. R. Bush, 440,308. Filed June 9, 1890.

"Quick-acting" hand switch.

Combined Lighting-Arrester and Cut-Out, J. A. McManman, 440,361. Filed Feb. 7, 1890.

Fusible cut-out; formation of arc between terminals intercepted by ground bar.

Adjustable Resistance for Electrical Circuits, C. Wirt, 440,384. Filed Nov. 26, 1888.

Two relatively movable concentric cylinders, one having wires longitudinally upon it, the other carrying a contact piece bearing directly upon the wires.

Railways and Appliances :—

Electric Motor Truck and Gear, E. Peckham, 440,189. Filed May 29, 1890.

System of gearing whereby the motion of armature shaft of motor may be imparted simultaneously to both axles of the truck.

Station-Indicator for Railway Cars, G. N. Vanderhoff, 440,208. Filed Dec. 2, 1889.

Electro-magnetic mechanism controlling movement of parts.

Electric Switch, M. Wheless, 440,213. Filed Sept. 24, 1889.

For electrical railways with sectional conductors. An electric circuit separated at intervals and having at each side of the points of separation sockets pointing in opposite directions, in combination with magnets placed at such points of separation, the armatures of the magnets being bifurcated, and the forks being on opposite sides of the main circuit and having screws fitting the sockets.

Electric Railway, J. K. P. Nourse, 440,362. Filed March 18, 1890.

For storage battery cars, system of conductors leading from power station to one or more points on the track for charging batteries in transit.

Electric Railway Switch and Signal Mechanism, J. Ramsey, 440,502. Filed March 21, 1889.

An electric motor employed to move a railway switch; mechanism transmitting motion from the motor to the switch so constructed that the motor circuit will be automatically broken when the switch has been either opened or closed.

Electric Switch and Signal Mechanism, J. Ramsey, 440,503. Filed March 21, 1889.

Signal operated by an electric motor provided with mechanism for setting the signal in one direction only, an automatic circuit breaker for cutting out the motor after it has actuated the signal, mechanism for cutting in a magnet circuit for holding the signal.

Electric Train-Signal, F. Sargent, 440,508. Filed May 6, 1890.

The operating valve of locomotive whistle actuated by electro-magnet.

Shipper for Trolleys, H. H. Brooks, 440,584. Filed May 14, 1890.

Two diverging pivoted arms, one on either side of the trolley and extending outwards from either face, the arms projecting normally when the trolley is in contact with the wire and below any portions of the overhead construction adjacent thereto.

Electric Railway. R. M. Hunter, 440,595. Filed May 29, 1889.

Supporting the conductors over one or more parallel tracks by a line of poles, and supporting working and supply conductors by the same poles or means of support.

Electric Railway, R. M. Hunter, 440,596. Filed July 28, 1890.

In two crossing railways, the main conductor of each is severed at the point of crossing; a bridging switch is provided to span the gap made by the severing of the main conductor.

Contact Device for Electric Cars, R. M. Hunter, 440,597. Filed Aug. 11, 1890.

Conduit railway. First claim as follows :—In an electric railway, the combination of a conductor extending along the railway, a traveling vehicle, a frame jointed at one end to the vehicle and having its other end free, and a current-collecting device carried upon the free end of the frame and movable about a vertical axis.

Secondary Batteries :—

Secondary Battery, Friedrich Marx, 440,175. Filed April 18, 1890.

Metal or metalline electrode and a carbon electrode placed in an aqueous solution of a salt of a metal and an equivalent quantity of an acid.

Electrode for Secondary Batteries, E. B. Weed, 440,210. Filed Feb. 8, 1890.

Constructed to permit a large amount of active material to be placed in receptacles and to reduce the weight of metallic plates.

Metallic supporting plates with outwardly projecting receptacles for active material; receptacles wholly enclosing the masses of active material.

Secondary Battery Plate, A. E. Wolfe, 440,216. Filed Feb. 10, 1890.

A plurality of supports for active material, the supports being conductors of electricity, and a layer of mechanically applied active material between and in contact with the surfaces of adjoining supports, and continuous open passages for the liquid through the supports and through the active material.

Process of Producing Porous Crystalized Metal Plates, C. Payen, 440,267. Filed July 26, 1887.

Fusing two or more metallic salts together, pouring the mass into a mold, allowing it to crystalize, then reducing the structure to a metallic state and eliminating foreign matter.

Process of Producing Crystalized Metallic Lead Plates, C. Payen, 440,268. Filed Jan. 16, 1888.

Fusing the salts of lead, zinc and cadmium, casting the mass in a mold and allowing it to crystalize, then reducing to a metallic state.

Process of Producing Crystallized Lead Plates, C. Payen, 440,269. Filed Jan. 23, 1888.

Fusing a salt of lead and an ammonium salt, then treating as in 440,267.

Art of Producing Crystallized Metal Plates, C. Payen, 440,270. Filed Mar. 12, 1888.

Fusing the salt of a metal having the salt of another metal and a metal or a salt of that metal mixed or combined therewith, pouring the mass into a mold and allowing it to crystallize in columns, then treating as above.

Porous Crystallized Metal Plate, C. Payen, 440,271. Filed March 16, 1888.

Plate produced as above.

Method of Making Porous Crystallized Metal Plates, C. Payen, 440,272. Filed June 16, 1888.

Mixing and melting a fusible metallic salt or salts with a salt or salts not decomposed or fused below a red heat, then treating as above.

Process of Making Porous Crystallized Metal Plates, C. Payen, 440,273. Filed June 16, 1888.

Fusing a metallic salt or salts containing a mineral acid or acids with a salt of lead, then treating as above.

Process of Producing Porous Crystalliz'd Metal Plates, C. Payen, 440,274. Filed June 18, 1888.

Fusing with a salt of a metal and oxide of a metal and a non-oxidized salt or compound of the same or another metal, then treating as above.

Process of Producing Porous Crystallized Metal Plates, C. Payen, 440,275. Filed June 18, 1888.

Fusing two or more metallic salts and an oxide or oxides of a metal or metals, then treating as above.

Process of Producing Porous Crystallized Metal Plates, C. Payen, 440,276. Filed June 20, 1888.

Fusing an inorganic metallic salt or salts with an organic salt or salts; then treating as above.

Process of Producing Crystalized Metallic Lead Plates, C. Payen, 440,277. Filed Jan. 16, 1888.

Fusing the salts of lead and cadmium, then treating as above.

Process of Producing Crystallized Metal Plates, C. Payen, 440,575. Filed May 31, 1888.

Fusing a salt or salts of a metal or metals and pouring the mixture into a mold, allowing it to cool, with the crystals of the mixture uniting with each other to form columns or needles, and with these columns or needles meeting with each other at or beyond the median line of the plate.

Electrolyte for Secondary Batteries, B. Renault and M Desvernay, 440,505. Filed Jan. 11, 1890.

A depolarizing gelatinous silica, consisting of a mixture of water, bichromate of soda and silicate of soda. A neutral gelatinous silica enclosing negative e lectrodes, consisting of water, silicate of soda, hydrochloric acid, sulphate of mercury, chloride of zinc and manganate chloride.

Telegraphs :—

Telegraph-Circuit, David H. Keeley, 440,164. Filed Nov. 4, 1889.

Elimination of static retardation. Pole-changing transmitter at sending station and a rapidly and constantly acting current-reverser at receiving station, for either neutralizing or augmenting in pulses transmitted.

Multiplex Telegraphy, David H. Keeley, 440,165. Filed Nov. 4, 1889.

Adaptation of synchronous multiplex telegraphy to way stations.

Induced-Current Telegraph, A. M. Rosebrugh, 440,199. Filed Feb. 3, 1886.

Signaling by secondary electrical currents. Inductorium and circuit closing key in primary circuit; rheotome or equivalent in primary circuit; secondary circuit of inductorium in main line, and a shunt around inductorium.

LEGAL NOTES.

STORAGE BATTERY INFRINGEMENT.

BRUSH *vs.* ANGLO-AMERICAN.

Suit has been brought in the United States Circuit Court for the Southern District of New York by the Brush Electric Co. and the Consolidated Electric Storage Co., of New York, against the Anglo-American Electric Light Manufacturing Co. for alleged infringement of certain United States patents, known as the Brush Storage Battery Patents, owned by the former companies. A preliminary injuction has been asked for. The bill of complaint setting forth the grounds of the action was filed by Messrs. Witter & Kenyon, attorneys for the complainants.

STATE AND LOCAL TAXATION OF ELECTRIC LIGHT PLANTS IN PENNSYLVANIA.

A decision by Judge Archibald, of Lackawanna county, rendered in the case of the city of Scranton *vs.* the Scranton Electric Light and Power Company, holds that the property necessary to carry out the corporate purposes of a corporation engaged in business of a public interest is not liable to local taxation, where such property is included in the capital stock which pays a State tax. Only those corporations which owe a well-recognized duty to the public, and which hold their property and exercise their franchises in subjection to that duty, fall within this class. An electric light company, incorporated under the acts of April 29, 1874, and June 2, 1887, to supply light, heat and power to the public, belongs to this class ; and its lands, buildings and appurtenances, necessary to carry out its corporate purposes, are exempt from local taxation, where such property is included in the capital stock, which pays a State tax.

THE CENTRAL ELECTRIC CO. are the general Western agents for the new Brennan wire connector, which was described and illustrated in a recent issue of THE ELECTRICAL ENGINEER. Among other new things they are introducing a new wood box bell of superior merits in ringing qualities, and at prices within the reach of all. This new bell should be inspected by intending bell purchasers and appreciated, as it possesses many valuable and important features.

THE PROPOSED PACIFIC CABLE.

A special dispatch from Ottawa, of Nov. 4, says: The project of connecting Australia with Canada by a cable across the Pacific Ocean has now been before the public about ten years, having been first suggested by Mr. Sandford Fleming in the report submitted to the Dominion Parliament in 1880. As a practical question, however, the history of the scheme may be said to date from 1887, when a conference of delegates from various parts of the British empire was held in London. At this meeting the plan was fully explained by the delegates from Canada—Mr. Sandford Fleming and Sir Alexander Campbell—and aroused a great, and for the most part a friendly, interest. At the last meeting there was also revealed the fact that the project had a strong opponent in the Eastern and Eastern Extension which now control the telegraphic communication between Australia and Great Britain and enjoy a monopoly which would be destroyed if telegrams could be sent across the Atlantic, then through Canada, and then across the Pacific Ocean to Australasia. The conference adopted a resolution declaring "that the connection of Canada with Australasia by a direct submarine telegraph across the Pacific is a project of high importance to the empire, and every doubt as to its practicability should, without delay, be set at rest by a thorough and exhaustive survey." The favor with which the idea was received appears to have alarmed the existing companies, for last summer they endeavored to make an arrangement which would have given their monopoly a new lease of life. They offered to reduce their cable rates one-half, on condition that the governments interested would give a guarantee equivalent to about £54,000 a year. The Australian colonies were willing to enter into this arrangement, but Great Britain and New Zealand declined to share in the guarantee, and there the matter stands to-day. In the meantime, Mr. Sandford Fleming took the opportunity to explain the Pacific plan. It was contended by Mr. Fleming that the guarantee asked for in consideration of the reduction of the rates of the old company, namely, £54,000 a year, would be equal to the annual charge upon the capital required for the construction of a cable from Canada to Australia. The length of the cable necessary to stretch across the Pacific from Canada to New Zealand and Australia is estimated by competent authorities at 8,900 miles, and Mr. Fleming says that the outside cost of a cable of the very best sort would be £1,800,000. Three per cent. upon this sum would amount to £54,000 a year. It is further pointed out that the building of the Canadian line would reduce the cost of messages from England to Australia to one-fourth what they are now, while the proposal of the existing companies is to reduce them by only one-half. The length of the line is not so formidable an obstacle to the success of the project as may at first sight appear, for, owing to the presence of a number of stations in the Pacific, the longest stretch would be about 2,700 miles, the others ranging from 1,200 miles upward.

PERRET MOTORS AND DYNAMOS.

The Elektron Manufacturing Co., of 79 and 81 Washington street, Brooklyn, has now organized an excellent corps of selling agents for its motors and dynamos of isolated incandescent lighting. They are: C. M. Barclay, 205 Canal street, Chicago; W. W. Donaldson, 215 North Calvert street, Baltimore; J. U. Burkett & Co., 1,409 New York avenue, Washington; F. J. Renz, St. Paul, Minn.; G. Baquie, 140 Gravier street, New Orleans, and Cleverly Electrical Works, 1,018 Chestnut street, Philadelphia. Mr. C. M. Barclay, who is one of the latest acquisitions, and who has the agency for Chicago and several of the Western States, for several years managed the stationary motor department of the old Sprague company in the same territory.

ELECTRIC RAILROADING IN SIOUX CITY, IOWA.

The Riverside Park Railway of Sioux City, which is now being built, have adopted the Westinghouse electric system, and the line will be open for traffic on or about April 1st, 1891. This company also owns the Sioux City & Highland Park Railway, a broad gauge suburban steam railroad, which will also be equipped with the same electric system and both operated together. The experiment of using electricity as a motive power on this line will be watched with a great deal of interest, as it is a regular broad gauge railroad constructed with regulation railroad ties and 50 pound steel "T" rail, and it gives a chance to demonstrate the utility of electricity versus steam on short railroad lines.

The combined electric railway system, as above, will be about nine miles and will afford two avenues of travel to Riverside Park, Sioux City's Summer resort. The Westinghouse Company will furnish extra powerful motors, geared for a speed of twenty-five miles per hour, and capable of handling an enormous travel during the Summer months. C. W. Hornick is president; W. W. Byam, vice-president; J. F. Peavey, secretary, and C. M. Swan, treasurer.

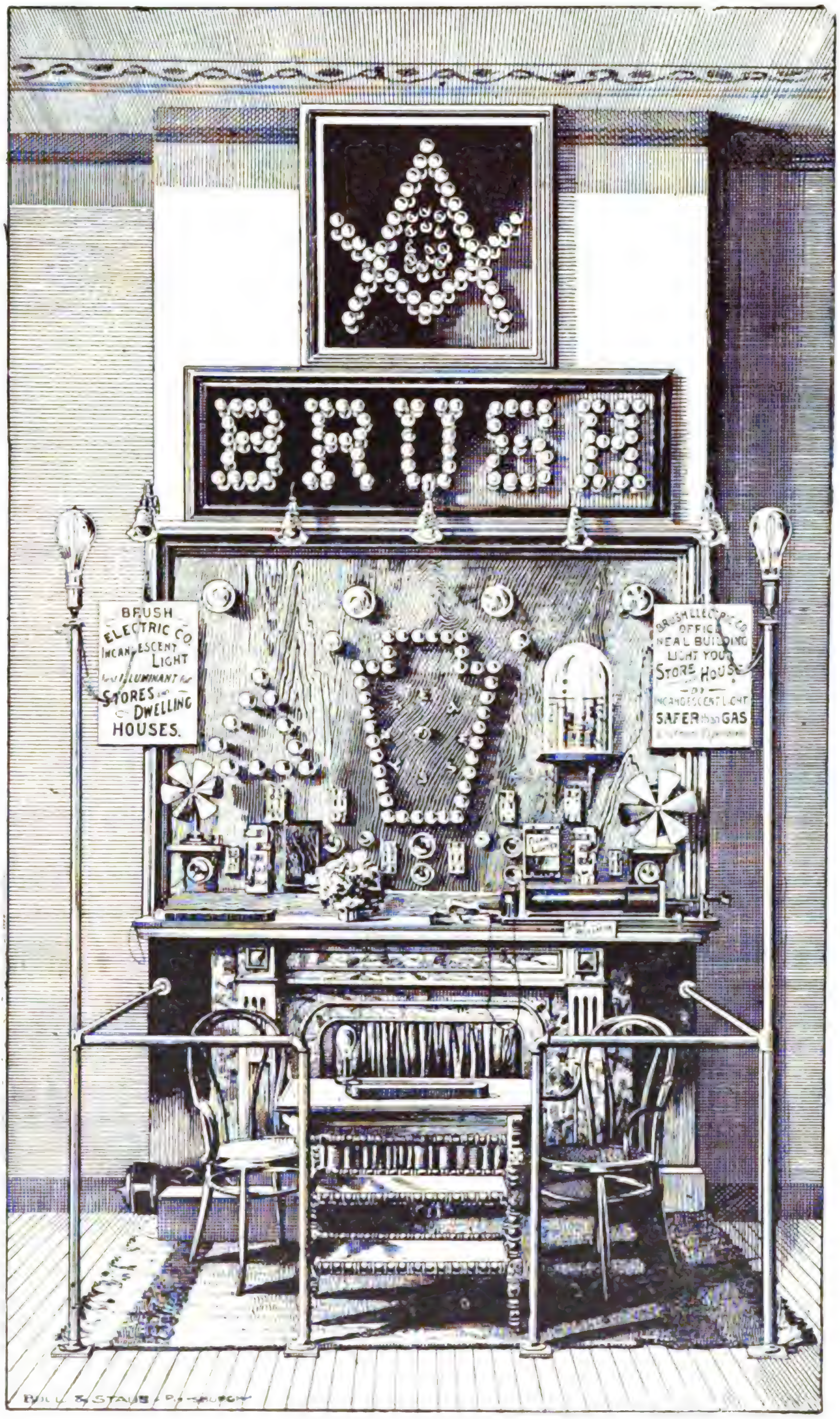
TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT

WORK OF THE LOCAL BRUSH CO., BALTIMORE.

THE Masonic fraternity of Baltimore, Md., has just concluded a very succesful "Bazaar" in the Masonic Temple of that city. The object of this entertainment was to raise funds, which are to be used in the interests of the Baltimore Masons. The Temple had been very gaily decorated; a fine orchestra of musicians had been hired to entertain the guests during the evening, and, in addition, the management of the Brush Electric Company, of Baltimore, had been prevailed upon to make an electrical exhibition in the hall to attract the people.

The accompanying cut is a faithful illustration of the display, representing a number of those features which are characteristic of the Westinghouse alternating current system, under which the Baltimore Company operates. Besides the seventeen arc lights and about 200 incandescent lamps, which the Brush Company burned in the hall, the exhibit consisted of a stage regulator, the Shallenberger alternating current meter and its method of working, then the cigar lighter, which attracted special attention; on the table in the front two coils representing the converters and showing that the system is perfectly safe and harmless. The two lamps on the top of the rails are 250 c. p. lamps. Down in the corner there are several small batteries and an induction coil. From this the attendant at the exhibit gave the visitors who desired it shocks. The square and compass, the keystone and other Masonic emblems were represented by incandescent globes of various colors, and the whole exhibit was very beautiful. Over 50,000 people have been to see the electrical display, it having been the first of its kind ever seen in Baltimore.



ELECTRIC DISPLAY AT THE MASONIC FAIR, BALTIMORE, MD.

Since the reorganization of the Brush Company in Baltimore the management has instituted some great improvements in the plant, and a good many more are even now contemplated.

The power house has a boiler capacity of 2,800 h. p. There are 4 Buckeye engines of 300 h. p. each, 5 Buckeye engines of 150 h. p. each, 2 Ball engines of 75 h. p. each, 3 Buckeye engines of 75 h. p. each, and 2 Westinghouse compound engines of 250 h. p. each, and there are the foundations built for two more of the same type. The company has Brush machines of 1,400 lights capacity, all driving from shafting with patent safe feeding oil system. The company also operates 250 arc and 1,000 incandescent lights of the Waterhouse system; 280 arc and about 400 incandescent lights of the United States Electric Lighting Company. The company is, however, controlled by the Westinghouse Electric and Manufacturing Company, which company is now supplying the Baltimore company with a number of additional alternating current apparatus. This includes two 250 Westinghouse alternating current arc machines, and two No. 3 alternating current incandescent machines. When these machines have been installed, the central station will have a capacity of 20,000 incandescent lamps.

The company at present furnishes the illumination for the Johns Hopkins Hospital, all the Baltimore theatres, and also to the majority of the principal buildings in the city.

INCREASING THE CAPACITY OF THE SCHUYLER FACTORY.

OCTOBER 1, 1887, the Schuyler Electric Company removed from Hartford to this city, says the Middletown, Conn., *Sentinel*, after several changes in the management, and located in the old Victor Sewing Machine shop on Hamlin street. The shop has been greatly improved, and other improvements are shortly to be made. A lot has been purchased that will give the factory an outlet on William street, and sufficient room to erect a new modern brick structure with twenty-inch walls and heavily timbered, adapted to the heavy machinery used in the construction of electric goods. This new addition will be 207 feet long by 60 feet wide. It will be three stories high, and the first and second floors will be thirteen feet eight inches between joists, and the third floor will be twelve feet in the clear. Work on the new structure will commence at once, and the management are in hopes of having it finished by the first of January, 1891, ready for occupancy; but they have some doubts about getting into the new building by that time. October 1, 1887, when the company located here, but 35 hands were on the pay roll, independent of the officers of the company. To-day 272 employés are found working within the walls of the busy structure. The multiplicity of orders compelled them to increase their help little by little

until now it is the number stated, and upon the completion of the new addition the working force will be doubled, making a total of over 500 men. For some months the management have been inconvenienced by the overcrowded condition of the factory which has greatly retarded them in their efforts in trying to fill orders. The new addition will double the present output of the company. The new building will be equipped with an elevator and all new modern machinery known to the trade. The orders for a week in several different departments have been doubled, especially in the electric meter room, which is enjoying an unusually large boom at the present time. The company, after having the order doubled to 200 a week, placed new tools in the room soas to fill their orders. The tools used in this department are of a very expensive nature, and an ordinary assortment, covering the top of an average writing desk, costs in the neighborhood of $4,000. After the tools had been put in, the order was again increased to 400 a week, and this placed the company again behind on their orders in this particular department. The company are engaged in the manufacture of their own patent goods, the following: The Schuyler dynamo, the safety ventilated armature, the Schuyler regulator, arc lamps, lamp hoods, series incandescent lamps, with many minor appliances too numerous to mention. Besides the manufacture of their own individual patents, they have large contracts from the Thomson-Houston Electric Co. The Schuyler system of electric lighting is in vogue in various cities throughout the United States and Mexico.

THE NEW DECORATIVE INSULATING MATERIALS.

The need of decorative effects in electrical appliances is beyond question. What sufficed for the pioneers in the industry will hardly do for the present day—in fact, it is obsolete. Just as sure and rapid as has been the demand for better line construction, more symmetrical poles and cross-arms, superior insulation and safety appliances, so sure and rapid is now the demand for interior fittings, possessing besides the necessary quality of usefulness, the equally necessary quality in our day, of finished appearance to match with the surrounding furnishings.

This result could never be reached without the aid of color. All that we have had so far, in the materials used for safety appliances and electrical appliances, has been plain white, the color of porcelain, or plain black, the color of hard rubber. Of course, wood at one time was extensively used in this connection, but cannot be so used now, because of the restrictions of the fire underwriters.

Of the materials which will bring about this change of appearance in electrical fittings there are four, principally, classified as follows:

Plasticon, which is of special value in the manufacture of switch handles, push buttons, etc. It can be made in all colors, and combinations of color; imitations of marble and natural woods can be produced. Besides being perfectly water-proof, this material will withstand a high degree of heat. Its beautiful appearance will find for it many uses, which now can only be surmised at. If brass parts are necessary in connection with its use, they can be embedded into the material, an advantage which will be readily appreciated.

Fibrone is a material similar in appearance to Plasticon, but standing a much higher degree of heat. It can be tapped and drilled, worked on a lathe, and can be finished with a high polish, similar to that given hard wood. Its low cost should not be lost sight of, in comparison with other materials, besides the fact that it can be given any color. It can also be worked in sheets of any thickness, and is therefore well adapted for the insulating parts used in sockets.

Alexite is absolutely fire, water and acid proof. It can be made in any shape and any color. The uses for which it appears best adapted, at first glance, are cut-outs, switch bases, insulators, cleats, etc. Brass parts can be firmly embedded in the molds, thus adding strength to beauty.

Herculite is also fire, water and acid proof, having something of the nature of fibrone. Having great tensile strength, it is adapted for many special electrical purposes, and from the fact that it can be readily drilled and tapped, can be used to advantage where the making of a mould is not justified by the quantity required.

All these materials will be put upon the market together, at reasonable prices, and by so well known a house as that of Alexander, Barney & Chapin, of the Telephone building, 20 Cortlandt street, this city. This firm, for some little time, have been exhibiting their "Alexite," but owing to the difficulty of procuring suitable buildings and machinery, have been unable to make it in any large quantity. This difficulty has been removed, however, by their most recent combination, by which they obtain the exclusive agency, for the United States and Canada, of the manufactures of the Fibrone Manufacturing Company, besides arranging with them for the manufacture of "Alexite." The factory of the Fibrone Manufacturing Co., at 300, 302 Monroe street, this city, which is at present equipped with all necessary tools, etc., will have added to its present machinery sixteen new, large hydraulic presses. Additional floor space has also been taken, so that orders stand a good chance of being filled promptly. The development of this really new industry will be attentively watched, as showing the many branches which are necessary in conjunction with the discovery and utilization of the great unknown, electricity.

J. M. LENNON, ELECTRICAL MANUFACTURERS' AGENT.

Mr. J. M. Lennon, E. E., of 22 Loan and Trust Co.'s building, Minneapolis, has issued the following card, which has a refreshing vigor and buoyancy about it: "I beg leave to inform you that I have added to my business at the above address, an electrical agency. My object in this is to act as agent, or more properly drummer, for any electrical or other firms who manufacture first-class A 1 goods in any way of use in the electrical business. I have a large and rich clientage and am certain that I can increase your business in the West and Northwest fully 100 per cent. I handle goods solely on commission and by sample, sending all orders directly to you, accompanied by the prices quoted and standing of prospective purchaser. Selling samples must, in all cases, be sent, except in cases of very large or very fine apparatus. Net prices on all goods must be quoted (to me), yet I shall endeavor to get the highest possible price with fairness and honesty."

IDE AND IDEAL ENGINES.

W. R. Fleming & Co., of 174 Fulton street, selling agents for the Foundry and Machine Dept., Harrisburg, Pa., have just taken orders for the equipment of several large steam ships belonging to the Transatlantica Hispanola line, with their self-oiling "Ideal" engines for electric purposes. This steamship company ranks among the three largest in existence, and is the one to which belonged the "Viscaya," which was recently sunk by collision attended with such disastrous results in loss of life. The "Viscaya" was to have been equipped at once by W. R. Fleming & Co.

They also report the receipt of many large orders for engines, and their superior steel return tubular boilers from electric light and street railways. Their works are running day and night.

SCHIEREN BELTS IN THE TORONTO ELECTRIC RAILWAY PLANT.

On August 20th, 1890, Chas. A. Schieren & Co. furnished the Metropolitan Street Railway Company, of Toronto, Ont., with the following belting: 48 feet, 12" double electric perforated belt, and 85 feet 28 inch. In answer to their inquiry they received the following letter: "Toronto, Nov. 8th, '90. In regard to the belts, as far as we are able to judge they are giving every satisfaction. We have certainly realized that the power required for electric railway purposes is very exceptional, and the demand is very irregular. We are glad however to state that the belts seem to meet all requirements. We have not had, so far, the slightest trouble with slippage, and cannot but express ourselves as greatly pleased. If they will stand the test of time we do not see that we can desire any improvement. If any parties in this market require anything of the kind we shall be very pleased to have you refer them to us, and will show them our belts in operation. Yours truly, Metropolitan St. Ry. Co., of Toronto, Chas. D. Warren, Pres."

CHADBOURNE, HAZELTON & CO.

When Chadbourne, Hazelton & Co. took the agency for the United States for the Wenstrom Consolidated Dynamo and Motor Co., last June, it was the intention of that company to equip their old factory at Locust Point with new machinery. They determined however later to build a new factory, and purchased 100 acres of ground and commenced operations. The new factory has been somewhat delayed owing to the extremely rainy season, and there is such a demand for Wenstrom apparatus that they are entirely unable with their old facilities to fill their orders.

At a recent meeting of the directors, the situation was discussed, and as a result, in order to hasten matters, the Wenstrom Company have rented a large factory in Baltimore already equipped with boilers, engines and shafting. The new factory is 60 feet front, 260 feet deep and is three stories high, and will be in working order by the last of this month. They expect to be able to turn out enough machines here by working day and night to fill their most pressing orders, and in the meantime will push to completion their large new factory at Calverton, which will be ready for operation by the early Spring to meet the Spring trade and the demand for street railway apparatus, to which this new factory will be almost entirely devoted. This will give the Wenstrom Company as good facilities as any company in the country, and by the first of the year they will be able to fill all orders on time.

CUT-OUT SWITCH FOR ARC OR SERIES CIRCUITS.

We illustrate in the accompanying engraving a new switch which has been specially designed by Mr. W. S. Hill, of 133

Cut-Out Switch For Series Circuits.

Oliver street, Boston, for use on arc or series circuits, so that one lamp or a loop carrying any number of lamps, may be cut safely out of circuit, without disturbing the remainder of the circuit. The inside working of the switch is very similar to the usual Hill type, the contacts being made in the usual way. When operating, the one set of contacts is always thrown in before breaking the other, so that there is no sparking, the actual working of the switch being accomplished by two levers carrying the contact points on a common axis, lying in opposite directions, and so arranged that when the one lever is pressed down the other is free. The mechanism is mounted on a slate base, and is protected in the usual Hill fashion by a substantial weather-proof iron case, provided with a glass front, to show the words "off" and "on" to prevent any possibility of error, as to whether a loop may be in circuit or not.

A NOVEL TROLLEY LINE WIRE HOLDER.

To the street railway engineer the method of suspending the trolley wire has proved a problem of no little difficulty and many devices have been tried and are being used to-day. Any improvement in these must be interesting, and we illustrate in the accompanying engraving a new form known as the Gould & Watson trolley wire clip, which is extremely simple and can be most easily applied. As is evident from the cut, this clip is intended to be used without solder, and at the same time requires no screws to bind the clip to the wire. The jaws are made in two pieces, and fit slackly over the wire when being applied, but when the nut is screwed up, it brings these jaws with a vise like grip upon the wire, and at the same time securely fastens the nut to the insulating material, not shown in the cut, but which may be of any of the several forms in use. The upper hole is furnished in either $\frac{3}{8}$ inch or $\frac{7}{16}$ inch sizes, and the jaws are made for either Nos. 0, 2 or 4 wire. The jaws are furnished of either the best composition metal or steel. One important feature of the clip is, that should sagging of a line take place at any time, it is an easy mat-

New Trolley Line Wire Holder.

ter to slacken up all the clips, which can be done by a quarter turn of the nut, when the wire can be pulled up taut and then the clips can be tightened up again. Practical tests have been made of this clip, with most satisfactory results, both on straight line and also upon corners carrying heavy cross strain. The clips are manufactured by the Gould & Watson Company, 35 Hartford street, Boston.

BROWN'S MINERAL ORE DETECTOR.

Electricity has already been applied in numerous ways to mining operations and with such success that a large extension of this work, both in electric lighting and power installations of various kinds, may be looked for in the near future. A recent addition to the application of electricity to mining, and one which seems destined to find considerable use, is a portable device for detecting the presence and nature of a mineral where the latter is exposed in the rock or earth. This apparatus, which is intended for the use of prospectors more particularly, consists of a battery and spark coil, which are enclosed in a box, and the conductors end in two platinum points.

It is evident that if these points be connected to a conducting body and the circuit ruptured, a spark will be formed, the flame and color of which will give some indication of the nature of the body which the electrodes have touched. Thus, by placing the two points against a rock containing metal in a free state, its presence may be detected by merely applying one electrode and passing the other rapidly over the surface.

The machine, which was invented by Mr. F. H. Brown, of Chicago, will, it is said, enable a novice or "tenderfoot" to pick

Brown's Mineral Ore Detector.

up float rocks on the hills and tell instantly whether they contain mineral or not, and even the comparative quantity in a rough way. By means of this instrument, also, it is possible to find a lost "lead" in a shaft or cut by applying it to the walls. Another use to which it may be put is to the sorting of ores, the color of the flame enabling the sorter to separate the different kinds. The apparatus, which weighs about ten pounds, is arranged to be carried on the back and can be used to explode blasts in connection with electric primers.

R. T. WHITE'S RAIL SPECIALTIES.

As our readers are aware, Mr. R. T. White has devoted considerable time and ingenuity to the improvement of rails, chairs, &c., for street railway work, and has secured patents on a number of his devices. He has now issued a circular to the public in which, as the result of what he heard and saw at the Buffalo Convention, he claims that the Lewis & Fowler Girder Rail Co., of Brooklyn, are directly infringing on his patents. He says he will proceed against those who purchase such track material from that company, of whom he remarks: "I have defeated them in all the interference suits between us in the Patent office, and am positive I can defeat them in the United States Courts, as I have patents and they have none."

Mr. J. H. Stahley, well known in electrical work in all parts of the country, has been placed in charge of the new street railway work at Flushing, N. Y.

THE KINTNER LABORATORY.

Mr. C. J. Kintner, the patent expert and electrical engineer, has an experimental laboratory with direct and alternating currents, in any desired proportions, having recently fitted up a room in the basement of 45 Broadway with Westinghouse converters connected to the street mains, and with connections to the direct current incandescent plant of the Aldrich building. He is thus in a most favorable position to make quick and thorough tests of new ideas and inventions.

OKONITE WIRE IN A WESTERN BUILDING.

The Central Electric Co., of Chicago, have just issued a facsimile of a letter received by them from S. G. Cook & Co., of Minneapolis, accompanying a piece of wire attached by red ribbon and seal—altogether quite an official looking document. The letter says: "This piece of Okonite wire was placed in our Lumber Exchange Building in this city 5 years ago and has been used continuously ever since as part of the electric lighting circuit of the building. The wire was originally stapled to the fireproofing and plastered over, and so far as we can see it is as good as ever." At the foot of the letter is a pertinent note from the Central Electric Co. to the effect that they are the Western agents for Okonite.

QUEEN & CO'S. PORTABLE TESTING SETS.

FROM the following flattering testimonials it appears that Queen & Co's. portable testing sets are appreciated quite as much by the public in general as by themselves.

Prof. T. C. Mendenhall, Supt. of the U. S. Coast and Geodetic Survey, says: "The set of resistance coils furnished by you some time since, has been used with great satisfaction. It possesses many advantages in the way of compactness and convenience of arrangement." Sec. H. J. Davies, of the Brooklyn St. R. R. Co., writes: "We are very much pleased with the portable testing set you sold us. We are using it constantly, and it is proving satisfactory." Asst. Engineer R. Fleming, of the Edison Gen. Electric Co., writes: "I would say that the portable testing set I bought of you recently has given every satisfaction, and, for an instrument of its class, surpasses anything I have ever seen for accuracy and reliability. I would heartily recommend it to electricians." Supt. H. A. Wagner, of the Missouri Electric Light & Power Co., says: "We are very much pleased with your new portable testing set, which we have been using about two months, and have no hesitation in saying that it is the best instrument for the price that we have seen. We had it compared with a standard Elliott bridge, and the readings when reduced to B. A. ohms, agreed with the former within one-tenth of one per cent. throughout the range tested." The Schæfer Electric Manufacturing Co. writes: "So far as we have been able to test the set has proved all we could wish for and well adapted to our purposes." Lieut. McLean, of the Newport Naval Torpedo Station, says: "The arrangement of the bridge arms, coils and keys in the portable Testing set, No. 126, is very convenient and satisfactory."

We are informed by Queen & Co. that up to date the orders for these sets have come so fast that it is impossible to turn them out fast enough. They have employed additional force, however, and hope soon to be able to carry a supply equal to the demand.

THE EQUITABLE ELECTRIC RAILWAY CONSTRUCTION CO.

Mr. W. A. Stadelman, who has for some time been connected with the firm of Chadbourne, Hazelton & Co., of Philadelphia, has recently terminated his active interest in that concern, and has reorganized the Equitable Electric Railway Construction Company, of which he was chief engineer. He will devote his entire energies to the new concern.

The new company will be known as the Equitable Engineering and Construction Company, and a new charter has been applied for which will give the company the right to not only equip electric railways but to buy and sell or lease or operate them. The old company will go out of business by liquidation, and the new company will take its place.

Handsome new offices in the Drexel building have been taken, and the new company have already several large contracts, one for an electric railway in the South, and one for a complete central station alternating current lighting plant, including engines, boilers, buildings, etc., to be erected near Philadelphia.

The capital of the new company is $50,000, and the officers are as follows: J. A. McKee, of the Tradesmen's National Bank, president; H. J. M. Cardeza, of Cardeza, Gilliams & Co., secretary and treasurer; W. A. Stadelman, manager and chief engineer. Directors: J. A. McKee, J. L. Stadelman, L. Gilliams, F. D. LaLanne, W. A. Stadelman.

NEW ENGLAND TRADE NOTES.

THE STANDARD ELECTRIC CO., OF VERMONT, have sold a 100-light plant to the Contrexeville Manufacturing Company, of Manville, R. I.

THE TROPICAL AMERICAN TELEPHONE CO., of Boston, besides the regular American Bell Telephone set, of which they have recently received a large consignment from the American Bell Telephone Company, are now offering for export, a new Tropical American Telephone Company export set, the magnets having platinum points, and all latest improvements. They are also making the "Williams" switch-board in a new form, after the style of the multiple switch-board, and have it in all sizes, and are exchanging these for old style boards or old style magneto bells on very reasonable terms. The new export set, offered at $15, is guaranteed to be first-class in every particular, and long distance telephone sets are now sold at the price formerly asked for the American Bell set.

THE STANDARD ELECTRIC SUPPLY CO. have secured the agency for the New England States of the New England switch, manufactured by O. S. Platt, of Bridgeport, Conn. These switches are mounted on wooden or porcelain bases as required, and vary in size from 10 to 100 amperes. They are already having a wide sale.

W. S. HILL, of Boston, has just brought out another of his well-known type of switches, this time for arc or series circuits. The switch is described in another column of this number and is well worthy of careful inspection.

WESTERN TRADE NOTES.

THE BELDING MOTOR AND MANUFACTURING CO., with offices in The Rookery, Chicago, are busy equipping a large factory for the manufacture of their well known motors. They have purchased 10 acres of land on the West Side 5¼ miles from the court house on the Milwaukee and St. Paul road, and the factory formerly occupied by the Garfield Locomotive Works. They are fitting it up with the latest and most approved machinery and expect to do away with belting and long lines of shafting altogether, transmitting their power and running the different departments with electric motors. They have some valuable contracts on hand, one for fifty 20 h. p. motors. Mr. C. H. Bunker, former secretary of the Abbott Buggy Company, of this city, has been elected secretary and treasurer of the company. Mr. N. S. Possons, who has been the general superintendent of the Brush Electric Company for 12 years past, has been appointed to fill the same position with this company for a term of years. Mr. Harold P. Brown has been appointed electrical engineer. The company expect to be in their new factory and able to turn out a number of street car motors a day besides taking care of their rapidly increasing motor business by the first of January.

MR. GEORGE CUTTER has resigned from the managership of The Great Western Electric Supply Co., and, it is rumored, has associated himself with Mr. Kempt, manager of the Brush Company, of this city.

THE CENTRAL ELECTRIC CO. have just booked orders for one hundred miles of improved Candee line wire to be used in alternating current work. This wire has achieved a most enviable reputation on account of its many excellent qualities for pole work and combines high insulation, toughness and remarkable durability. Their trade in other lines is proportionately as good and the amount of business they handle is continually increasing, due to the excellence of their goods and equitable business methods.

ST. LOUIS TRADE NOTES.

GUIDO PANTALEONI, Western representative of the Westinghouse Electric Co., has closed contracts for an installation of 1,500 lights for the Lincoln, Neb., Gas Company, the old Lincoln Electric Light Co. having been sold to the gas company. The entire station will be rebuilt. The total capacity of the station will be 4,000 lights. The meter system will be used.

The Westinghouse station in South Omaha will install 1,000 lights, making their total capacity 1,750 lights. The meter system will be introduced. Kirksville, Mo., has contracted for the installation of 750 lights, Rich Hill, Mo., 500 lights, Mason City, Ills., 750, Mt. Vernon Car Co., Mt. Vernon, Ills., 300 lights, Rockport, Tex., 750 lights, Taylor, Tex., 750 lights. Contracts have also been closed for an electric railway equipment of 12 cars at Salt Lake City, Utah, and 10 cars at Terre Haute, Ind. The Westinghouse electric railways at Springfield, Mo., and Pittsburg, Kan., and Des Moines, Iowa, have been finished and are now in successful operation.

W. L. ARNOLD, who has been looking after the interests of the Excelsior constant current motor for a year past, has disposed of 17 motors. Among late sales was a 2 h. p. Excelsior motor to the Mound City Roll Paper Co., 2 h. p. motor to Julius Buechel, printer, and 1 h. p. motor to Hy. Sallwasser.

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LIGHTING THE COUNTRY SEAT OF VICE-PRESIDENT MORTON.

BY M. C. SULLIVAN.

EVERY feature of the electrical industry becomes interesting to the electrical engineer and the public in just that proportion that it proves its value by the most severe and convincing of all tests—Time, and it is generally admitted that those electrical inventions and devices which testify to their usefulness by actual service in the home, the public building, the street and on the railroad, must be considered as applications of the electric current that become necessities.

On a recent visit to Ellerslie-on-the-Hudson, it has been the pleasure of the writer to witness the continued successful operation of the electric lighting plant installed in the country residence of Vice-President Levi P. Morton, after nearly three years actual service. This installation has many interesting features, and can be considered as a model of its kind, it being one of the places where the great utility of the storage battery in the lighting of a country home is clearly demonstrated.

In lighting such a home as this, situated a long distance from any city, by electricity direct, the dynamo cannot be kept constantly running, notwithstanding the importance of having the light always ready for use, whether one or the whole number of lamps installed are needed, and it is here that the storage battery plays an important part in electric illumination.

This plant, Figs. 1 and 2, was installed in the spring of 1888. It consists of 198 15 L accumulator cells manufactured by the Accumulator Co., of this city. These cells are coupled in 6 groups of 33 each. These groups are connected in series by a transfer switch on each rack when being charged from the dynamo situated nearly half a mile away, but are coupled in multiple when supplying current to the lamps. With a current of 40 amperes, requiring 28 mechanical horse-power, the cells can be charged in 8 hours; or, with a current of 30 amperes, requiring 21 horse-power, in 10 hours. They are operated on the following basis:

When the batteries are fully charged they have a capacity equivalent to 1800 ampere hours, which can be discharged in any quantity up to 250 amperes, which is the maximum point of discharge. Sixty volt Sawyer-Man lamps are used, requiring .84 ampere each, so that 300 lamps can be lighted at once, and the battery will sustain the entire number continuously for 7 hours. The regulation of the lamps is accomplished by cutting in or out an extra cell in each series by means of a switch placed on the switchboard on each rack shown in the cut.

The E. M. F. of a storage battery falls slightly as it becomes discharged, and this drop is provided for by the introduction of an additional cell or two in the series.

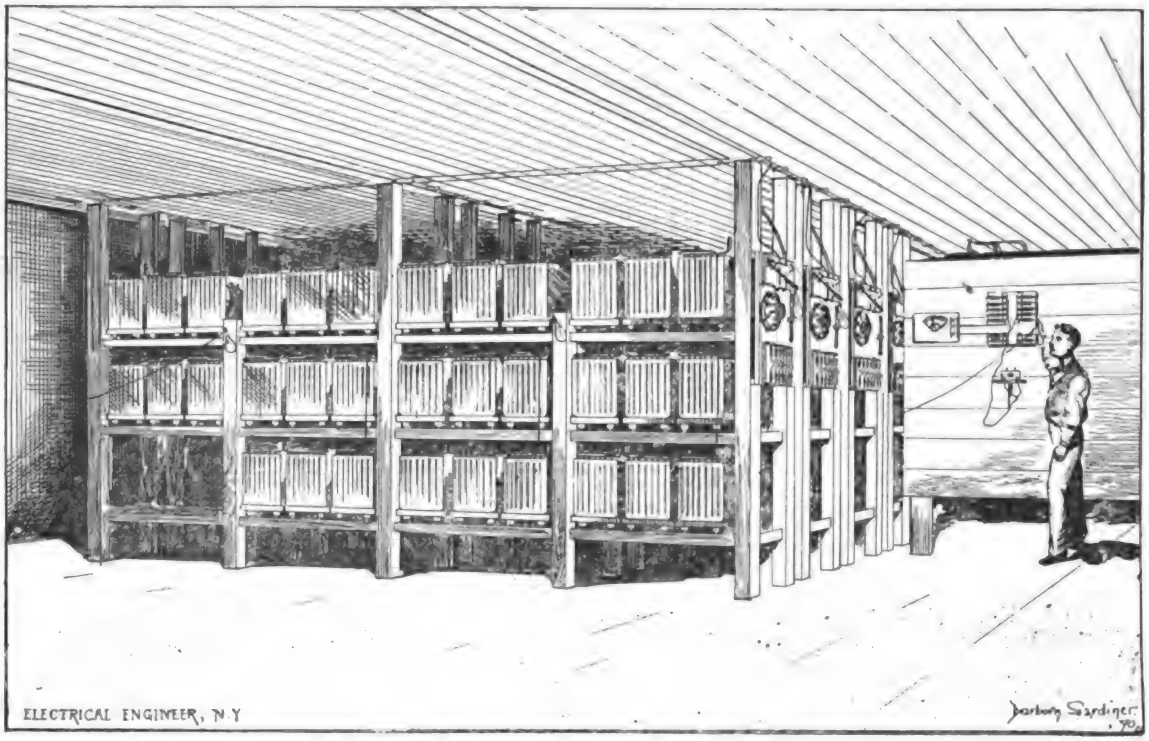


FIG. 1.—ACCUMULATOR PLANT IN RESIDENCE OF LEVI P. MORTON, RHINECLIFF, N. Y.

The above is what the plant is capable of doing, and the time taken to charge it is based on the inquiry: How much current has been taken from them? The E. M. F. of the battery is never allowed to drop below 2 volts per cell. The time required to charge these batteries depends, of course, on the amount of current used since the preceding charge. The method which has been adopted is to commence charging with the amperemeter reading 33, and as the cells become charged the pointer moves back to 25 or 28, or thereabouts.

The average number of lamps burned each day is 85 for about 5 hours, the greatest number of lamps in use at any one time being 250. This average holds good for every day in the week, and it is only necessary to run the engine for 15 hours during that period to charge the batteries, so that 7 hours operation one day and 8 hours another is sufficient to generate the requisite current for the week. This is done in the day time. In this way the dynamo becomes simply an inexhaustible source of supply, while the batteries do the active work.

The dynamo used is a specially shunt wound Thomson-Houston, having a capacity of 30 amperes and 500 volts at 1250 revolutions per minute.

The apparatus connecting the dynamo with the batteries is so arranged that should an accident happen whereby the E. M. F. of the dynamo falls below that of the cells when being charged, no trouble will ensue, as an automatic switch will immediately open the circuit.

When the batteries are fully charged, the wires which are used to conduct the current from the dynamo to the cells are utilized to conduct back sufficient current to light the engine house, dairy and cattle barns. These buildings are located half a mile from the mansion. They are fitted with all modern appliances and conveniences, and the sight of cows and sheep eating by the aid of the incandescent lamp makes one believe that primitive nature is already, as it should be, on the friendliest terms with the most advanced department of science.

The wires from the engine house (a pretty piece of architecture shown in the initial letter of this article) to the battery-room, which is located in the cellar of the mansion, are run underground. For half the distance the Standard underground cable is used; the other half, Grimshaw "White Core," placed in Georgia pine troughing to prevent mechanical injury to the insulation.

The stable and laundry, situated some distance from the house, is lighted from the batteries, the wires being run underground.

The feature of a constant supply of current brings to notice a novel and interesting department of burglar alarm signals. The wiring of the house is so arranged that should any window or door be tampered with, a special automatic switching device will throw into circuit a number of lights, thus giving the nocturnal visitor a bright and warm welcome.

The engine used to drive the dynamo is a 35 h. p. Straight Line engine, which, with steam equipment, was installed by Messrs. Potter and Williams, of New York.

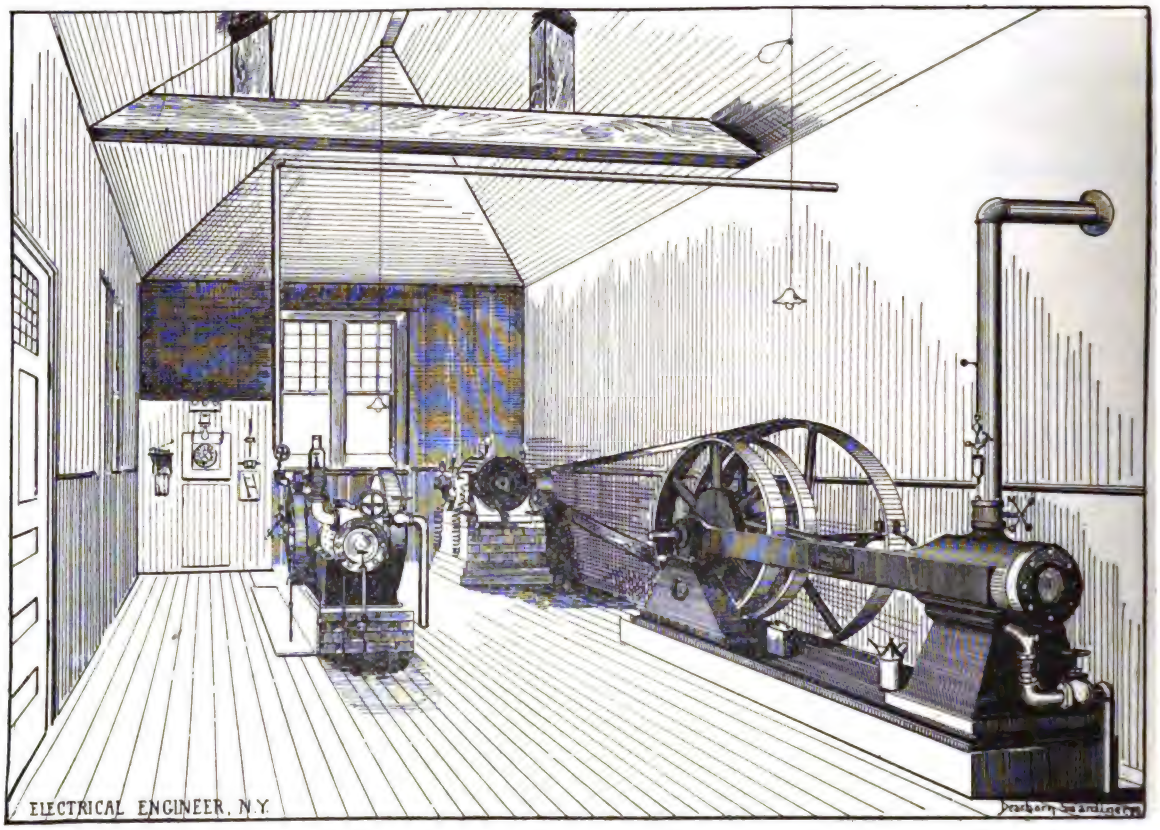


FIG. 2.—DYNAMO ROOM, ELECTRIC LIGHTING PLANT, RHINECLIFF, N. Y.

A journey through these grounds at night is a treat. One finds the electric lamp everywhere, but no other evidence of an incandescent system. There is no engine house in operation with its whirr of machinery and pillar of smoke so common in isolated plants. The lamps draw their life blood from some hidden mysterious source, and the visitor comes away impressed with the perfection and beauty of the incandescent lamp as a means of illumination.

An isolated gasoline plant was installed to provide against any drawback in the electric system. While this is a wise precaution that no fault need be found with, three years experience has not once called it into use to do service while its powerful rival "nodded."

A recent examination of the plant does not disclose any trace of deterioration, and the cells and apparatus are, to the personal knowledge of the writer, who assisted in making the installation in 1887, in as good condition as when turned over to the engineer since in charge of them.

A PRACTICAL GUIDE TO THE TESTING OF INSULATED WIRES AND CABLES.—II.

BY HERBERT LAWS WEBB.

HAVING seen just what is done in each test, let us now proceed to examine the actual instruments required for carrying them out and the methods of connecting up the instruments in practice.

GALVANOMETERS.

The most important instrument in any testing outfit is the galvanometer, as it is by means of the indications of the galvanometer that comparisons are made between the wires or cables to be tested and the standard instruments, such as high resistances, condensers and resistance coils.

The galvanometer usually employed for fine testing is that known as the Thomson reflecting galvanometer; this instrument is made in a great number of different forms,

Fig. 8.—Astatic Galvanometer.

of which it will be necessary for our purposes to describe only the two or three which are most used in general work.

The usual form of the astatic reflecting galvanometer is shown in Fig. 8. It consists of a hard rubber base mounted on three leveling screws and provided with either a circular level or two short spirit-levels placed at right angles to each other, so that the instrument may be accurately leveled when set up. Mounted perpendicularly on the base are the four galvanometer coils, the two at the rear being fixed and the front two hinged so that the astatic needle system can be removed if necessary. At the top of the brass frame to which the coils are attached is a hole into which fits a small brass stud. From the lower part of this stud is suspended, by a single fibre of raw silk, the astatic system of needles, consisting of two small pieces of steel, strongly magnetized, connected together by a fine aluminum wire, the N pole of the lower needle being beneath the S pole of the upper. By this arrangement the directive force of the earth's magnetism is minimized and greater sensitiveness obtained.

To the upper needle is attached a small mirror by means of which a spot of light is reflected on to a graduated scale; at right angles to the lower needle a small vane is fixed in order to check the swinging of the needles and bring them to rest quickly. The brass stud from which the needles are suspended can be lowered so that the vane rests on the coils; all strain is then taken off the silk fibre and the instrument can be moved without risk of breaking the fibre, but it should never be carried about without taking this precaution.

In raising the brass stud care should be taken to merely press it gently upwards by squeezing the fingers in between the head of the stud and the frame; on no account *twist* the stud, as in this way torsion would be put into the fibre and trouble from unequal deflections on opposite sides of the scale would be the result.

The coils are enclosed by a case of brass with plate glass front and back, or by a glass cylinder.

To the top of the case is fixed a rod which supports a very weak permanent magnet by which the needles may be directed so as to bring the spot to any part of the scale; by lowering or raising the magnet on the rod the sensitiveness of the needle may be diminished or increased. For fine adjustments the rod and magnet can be turned together by a tangent screw on the top of the case.

For reading the deflections of this galvanometer a lamp and scale are provided, the light from the lamp being focussed on the mirror of the galvanometer, which reflects back a spot of light on the scale. The scale is usually of cardboard and is divided into 360 divisions on each side of the zero. The spot of light may be either a fine narrow streak covering about one division of the scale, or a round spot with a black line across the centre, the line being produced by a fine wire being stretched across the orifice behind the lens. For a cardboard scale the round spot with the black line is preferable, as the part of the scale on each side of the deflection is illuminated and readings can be made with greater comfort to the observer. Many prefer using a ground glass scale, which is ruled in the same manner as the cardboard scale. The lamp in this case is placed at the side of the scale and the beam of light is reflected to the galvanometer by means of a small mirror mounted on an arm having a universal joint. The observer stands behind the scale, instead of in front of it, and the "spot" appears to him as a line of light on the dark ground glass. With this kind of scale a capital spot can be obtained by using as the source of light an incandescent lamp with a very straight filament, and either getting the two legs of the filament in line, or, better still, so arranging the lamp that one leg of the filament only is reflected by the mirror. In this way a sharply defined line of light is obtained and very close readings can be made.

The advantages of the ground glass scale are that the spot can be seen plainly even though the testing room is very light, and, that as the observer has not to place himself at one side of the scale but directly behind it, he is in a better position for manipulating the instruments and can allow himself more sea-room in setting them up. About the only disadvantage is that it is necessary to follow the movements of the spot pretty closely as it is almost invisible except from exactly behind the part of the scale to which it is deflected.

In setting up the galvanometer care should be taken to select a steady place. In cable factories a masonry pedestal with a good foundation, and not touched by any other part of the building, is generally constructed for the purpose, and in this way the galvanometer is kept free from vibration or jarring. In many places, however, such facilities are not obtainable and it is often necessary to set up the instruments in a room on an upper story, and in a building where heavy machinery is working almost continually. It then becomes necessary to resort to various

devices to free the galvanometer from the effects of the vibration of the building. If the building is of very solid construction a substantial shelf, firmly fixed to the wall, should provide a steady place; if vibration is still felt, a sheet of rubber or some thick rubber rings should be placed on the shelf and above this a heavy slab of lead, the galvanometer being placed on top.

The most sightly way of arranging this is to have a neat wooden case for containing the lead, which may be run in melted or in the form of fine shot. If this plan does not answer, a tray of sand may be substituted for the rubber, the weight being placed on the sand. The last expedient of all is to suspend the galvanometer by means of springs.

The usual plan is to place the galvanometer on a tray hung from a bracket by four coiled brass springs about three feet long. The tray is damped either by means of vanes working in air-tight boxes below, or by fixing brushes at the sides, the brushes just bearing against the edges of the tray. By this arrangement all vibration may be got rid of, but great care is needed in moving about not to touch the springs, or, in fact, any part of the hanging tray as the least jar is sufficient to set the needle dancing for some minutes.

When the galvanometer is set up it should be placed on a dry surface and the hard rubber base should be clean and dry; if there is any likelihood of moisture being present in the air, small pieces or cups of hard rubber should be put under the leveling screws in order that the instrument may be thoroughly insulated. When possible it is best to place the galvanometer facing west, the needles being north and south; but it is often necessary to have it face east, according to the position of the room set apart for testing.

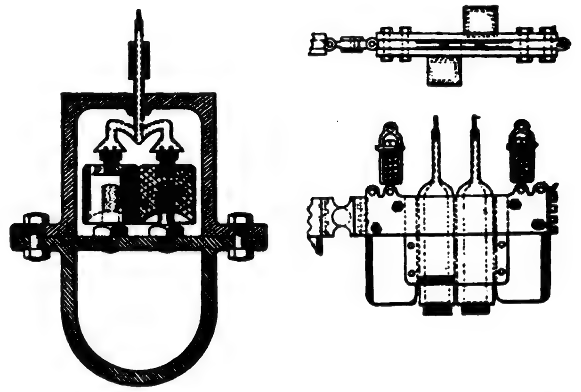
A good astatic galvanometer will not be affected by magnetic disturbances if the disturbing influences are more than a very short distance away, but if magnets, or iron tools, etc., are being constantly moved about within ten or twenty feet of the galvanometer, some sort of magnetic shield will be required to avoid the oscillations of the needle which would be the natural result. The most effective magnetic shield is an old iron safe, a hole being cut in the door large enough to allow of the free transmission of the beam from the mirror when the needle is deflected to its fullest extent. A box of sheet iron will be found more manageable than a safe and may be suspended from springs in the manner described above, thus getting rid both of vibration and magnetic disturbance.

The principal objection to the use of an iron shield completely enclosing the galvanometer is the inconvenience in altering the height or position of the directing magnet. The best combination of magnetic shield and hanging tray is to have the iron box supported on a shelf, and the galvanometer suspended by means of springs passing through holes in the top of the box. To obviate the difficulty referred to above, of altering the position of the directing magnet without disturbing the galvanometer, the rod supporting the magnet is fixed to the under part of the top of the iron box, and the tangent screw is prolonged so that the milled head is outside the box. In this manner the magnet can be raised or lowered without touching the galvanometer, and the direction of the magnet can be altered by means of the screw without opening the box. Such an arrangement as this is a very efficient preventitive both for magnetic and mechanical disturbances, and it has the advantage that the parts of the suspended spring contrivance which would ordinarily be exposed to accidental jarring are rendered inaccessible by being enclosed in the iron box.

The regular pattern astatic reflecting galvanometer is generally wound to about 8,000 or 10,000 ohms resistance, and sometimes even higher. The fine silk-covered wire is wound on four separate bobbins, as already described; the ends of the coils are led to eight terminals on the base plate, four in front and four in the rear, and by varying the connections between these terminals, the combined resistance of the four coils may be varied. A diagram of these connections is always supplied by the manufacturer, but for general work it is rarely, if ever, necessary to use the coils in any other manner than all in series, so as to obtain the maximum resistance.

CAPT. TROTT'S CONDUIT BRUSH CONTACT.

Past experience has shown that in addition to the insulation of the conductors in the conduit great care must be taken to prevent leakage of the current through the wires attached to the contact plow and leading to the motor. To guard against this, Capt. Samuel Trott, of the cable ship "Minia," has designed a brush contact, which, besides insulating the conductors leading to the motor, protects them from abrasion. As will be seen in the accompanying engravings, Figs. 1, 2 and 3, which show the



Figs. 1, 2 and 3.—Trott's Conduit Brush Holder.

brush in different views, respectively, each of the conductors is encased in insulating material, and at the point where the brush is attached to its holder the insulating material is spread out into the form of a hood, in order to protect the brush from falling moisture, the brush being arranged vertically to make contact with the upper surface of the conducting-rail. The two insulated conductors are enclosed in a carrier which travels in the slot of the conduit, and are thus protected from injury by contact with the conduit or any obstruction or foreign matter which may collect in the slot. The carrier is made of two thin plates which clamp the insulated conductors between them, the plates receiving between them at each end and being screwed to a thick vertical plate which acts as a plow. The carrier is supported from the car by means of a spring at each end. This device constitutes an elastic connection between the car and the carrier and enables the brushes to be readily adjusted in relation to the conducting-rails. Those sides of the hood which cross the conducting-rail have lipped edges, by which means the falling moisture is deposited upon each side of the conducting-rail.

CHEMICALLY PURE ZINC.

According to *l'Electricien*, M. Cahaigne, of Paris, has succeeded in producing chemically pure zinc on a commercial scale and at a price but little higher than that of ordinary zinc. MM. Pouchard, Mathieux et Cie., makers of electric clocks, have used Cahaigne zinc rods in the Leclanché cells employed by them. The cells in question furnished current for about 90 hours, and the consumption of the chemically pure zinc amounted to 28 grms. per cell, while the consumption of ordinary well-amalgamated zincs amounted to 36 to 38 grms. The Cahaigne zinc was, moreover, uniformly consumed, while the amalgamated rods were very irregularly attacked.

THE CITY AND SOUTH LONDON RAILWAY.[1]

This railway, which was opened on Nov. 4, is a subway, passing from a point in King William street, City, under the Thames, and on to Stockwell, which has been constructed on a novel method, designed by Mr. Greathead, M. I. C. E., in the form of two circular iron tunnels, 10

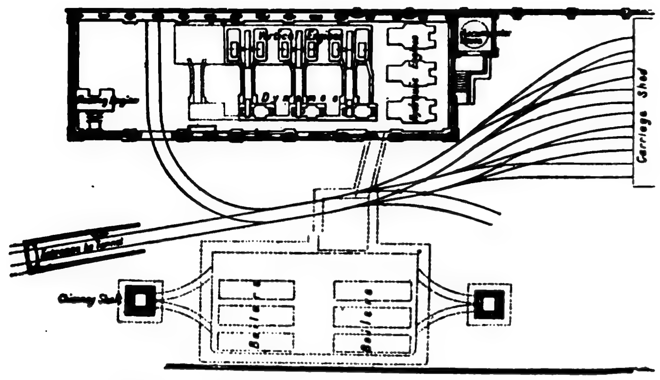


Fig. 1.—Plan of Generating Station.

feet in diameter, driven throughout the London clay, and about 60 feet below the surface.

The two tunnels, which reach from King William's Statue, in the city, to Stockwell, after having passed under the bed of the Thames, have been executed by the compressed air system in the face of a subterranean difficulty which could hardly be exceeded—namely, a powerful underground river, percolating through a gravel bed of large flints and coarse pebbles. This water-flow was kept back for weeks upon weeks by the sheer force of volumes of compressed air, whilst concrete and cement-grout were poured in front of the tunnel shield, and an artificial rock extemporized, in which the segments of the iron tunnel tube could be bolted together.

All the anxieties of the engineering work are over, the rails of the road are laid, the platforms erected, and the neatly constructed underground stations, with their walls lined with white glazed tiles, are ready for the passengers, and have a cleaner and brighter aspect than any of the other underground stations in London. Moreover, they will not be sullied with smoke and dirt from steam locomotives.

A scheme to work this railway by electricity to avoid

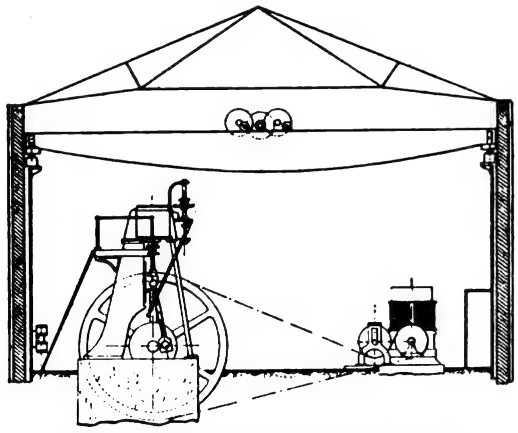


Fig. 2.—Engine and Dynamo Room.

the use of steam and its noxious results, or the use of rope traction with slow speed and other disadvantages, was submitted to the company by Messrs. Mather and Platt, engineers, Manchester. The company accepted the scheme, which is entirely original in its main features, though based upon the experience obtained by Dr. Edward Hopkinson, a partner of the above firm, in the construction of the Bessbrook and Newry narrow-gauge electrical railway in Ireland. The contract for the carrying out of the whole scheme, designed by Messrs. Mather and Platt, was committed to that firm. They have employed Messrs. John Fowler & Co., of Leeds, to supply the boilers and engines to work the dynamos for generating the current of electricity; also, Messrs. Beyer, Peacock & Co. to construct the framework of their electrical locomotives. The whole electrical plant has been carried out under the special superintendence of Dr. Edward Hopkinson, F. R. S., who has acted throughout as consulting engineer, with Mr. G. A. Grindle as resident engineer.

The following are the particulars of the plan of Messrs. Mather and Platt, and details of various parts of the work:

The whole of the plant for generating the electrical current is situated at Stockwell, the suburban terminus of the line. At this point a complete plant, Fig. 1, has been erected for the generation of the current. There are three large generator dynamos of the Edison-Hopkinson type, each worked independently by a vertical compound engine, designed and constructed by Messrs. John Fowler & Co., Fig. 2.

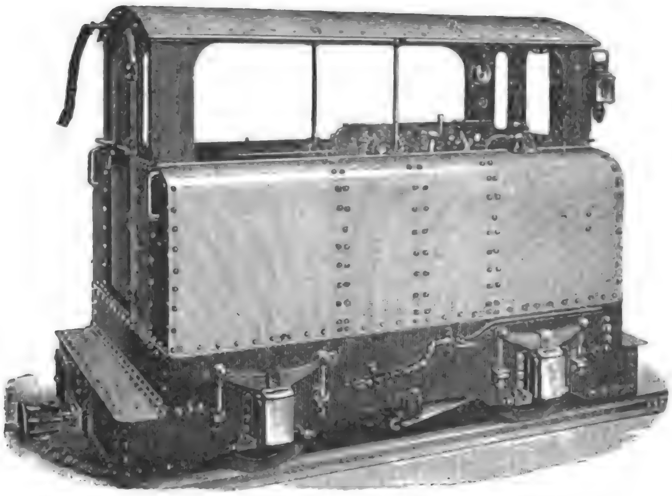


Fig. 3.—Electric Locomotive, City and South London Railway.

The engines work at a steam pressure of 140 lbs. per square inch, and have been built of exceptionally massive proportions. They run at 100 revolutions per minute, giving a piston speed of 450 feet per minute. They are fitted with automatic expansion gear of improved type on both the high and low pressure cylinders, and are controlled by a powerful governor, having a capacity of 750 foot-pounds, which is driven direct from the crank-shaft by cotton ropes. The automatic gear is so arranged as to cut off the steam, if necessary, in both cylinders from dead cut-off to three-quarters of stroke. The engines will indicate up to 375 h. p. each. The cylinders are steam-jacketted, the high-pressure is 17 inches diameter, and the low-pressure 27 inches.

The engines are supplied with steam from six Lancashire boilers, 7 feet diameter by 28 feet long, which are fitted with Vicar's mechanical stokers. Two large feed water heaters are also supplied, with brass tubes of ample surface, for receiving the whole of the exhaust steam from the engine without back pressure.

The generator dynamos are of the Edison-Hopkinson type, with bar armatures, fitted with all the latest improvements of Messrs. Mather and Platt. The weight of the armature alone is about 2 tons, and the weight of the entire machine something over 17 tons. Each machine is capable of generating 450 volts and 450 amperes. The commutators are of hard copper insulated with mica, and

1. London *Electrical Review*.

there are three brushes on each rocking arm, each separately adjustable, with bring-forward thrust and hold-off catch. The magnet limbs are exceedingly massive, each limb, with its pole piece, weighing over 4 tons, and the yoke of the machine weighs about 3 tons.

The machine can be run as compound, or shunt, only, as required. The total weight of copper wire on the magnet of each machine is nearly 1½ tons. The Edison-Hopkinson dynamo is well known as being perhaps the most efficient machine constructed. The present machines have an electrical efficiency of 96 per cent., or slightly over, and the measured efficiency of the engine and dynamo, *i. e.*, ratio of the electric power available outside the dynamo to the indicated h. p. of the engine, is over 75 per cent.

Sir William Thomson's multicellular electrostatic voltmeters are used for measuring the electromotive force. The current from the dynamos is conveyed to a general distributing and testing switchboard, fixed in a recess of the engine house. From this board the main circuits are taken to various parts of the line, and the current passing through each circuit is measured, and suitable arrangements are provided for switching over from one circuit to another.

The site occupied is a plot of about two or three acres on the surface, or ground level. The access between the depot

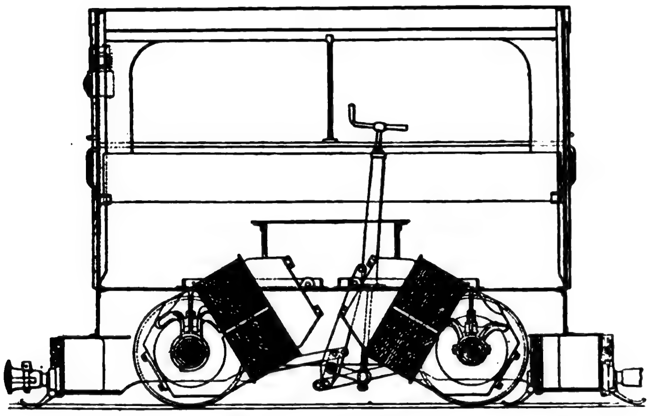


FIG. 4.—ELECTRIC LOCOMOTIVE WITH DIRECT DRIVERS.

and the subway is by a curved tunnel descending from above ground by a steep incline of 1 in 3½ feet. Up and down this the trains are brought or lowered by a rope and winding engine. This short bit of tunnel is remarkable. Formed on a horizontal radius of 250 feet and a severe vertical radius, it is marvelous that the junction of the two drivings, one from below and the other from above, should have met centre for centre and level for level within an inch or two. At the depot the carriage shed is large enough to contain six trains side by side.

The main cables have been manufactured by the Fowler-Waring Co., of North Woolwich, and consist of a copper core of 61/14 B. W. G., insulated with Fowler-Waring insulating material, and lead-sheathed.

The working conductor is of channel steel, carried on glass insulators, the joints being fished and also connected with copper strips. The general arrangement of the working conductor is exactly the same as that employed by Dr. Edward Hopkinson on the Bessbrook and Newry line. The steel employed is of very high conductivity, and has been rolled specially for the purpose by the Shelton Iron and Steel Co., of Stoke-on-Trent. The working conductor is divided into sections for convenience of testing and carrying out repairs on the permanent way. The insulation obtained is extraordinarily high. When the full pressure of 500 volts is on the complete system of working and feeding conductors, the leakage current does not exceed one ampere, so that the total loss by leakage is less than 1 h. p.; this is a small fraction of 1 per cent. of the total power required for working the line to its full capacity. The current is collected from the working conductor by sliding shoes of iron or steel arranged in a very similar way to that employed on the Bessbrook line.

Fourteen 10-ton electric locomotives of the type shown in Fig. 3 have been supplied by Messrs. Mather and Platt for working the line, each capable of developing up to 100 effective h. p., and of running up to 25 or 26 miles per hour. The armatures of the locomotives are constructed so that the shaft of the armature is the axle of the locomotive, Fig. 4; in this way all intermediate gear and all reciprocating parts are entirely obviated. The locomotives have a fixed wheel base and a motor is fitted on each axle, the axles not being coupled, but working quite independently. The current is conveyed from the collecting shoes through an amperemeter to a regulating switch, then to a reversing switch, thence to the magnets, and back through the framework of the locomotive to the rails, so completing the electrical circuit. The locomotives are fitted with Westinghouse automatic air brakes, and also a screw hand brake, and they are lighted from the working conductor. The train, when loaded, will weigh 30 tons, and it is intended that ten trains shall be worked on the line at one time.

Each train consists of an electric locomotive and three passenger carriages 32 feet in length from end to end of the footboard. The long passenger carriages are pivoted on two four-wheeled bogies; and the interior, which is divided by a door in the centre, contains seating for 34 persons. The enclosed portion is 2ɜ feet in length, the external overhang of the carriage platform being coupled up to the similar overhang of the adjoining carriage, and thus forming two open platforms between the three carriages. Upon each of these a guard travels with the train. These guards' platforms are protected at the sides by iron lattice sliding doors. The carriages are lighted by electric light, the current for the lamps being, in like manner, taken off from the conductor.

Each train carries its own reservoir of compressed air, sufficient for 40 stoppages, and as it arrives at the depot station of the line, recharges its air supply. The trains are also fitted with hand brakes, the stopping power being thus completely independent of the motive power.

In the generating house is the hydraulic machinery for supplying power to the elevators at the various stations. The cylinder of the ram is 2 feet in diameter, and the wrought iron flange-jointed pipes, which convey the water at a pressure of 1,200 lbs. to the square inch, are nearly a foot in external diameter. The engines which pump the water into them act automatically, being put in motion as the accumulator descends by loss of water at the elevators. At the end of this building is a locomotive repairing shop, with special appliances for lifting out or replacing the dynamos on the locomotives.

The limit of speed of the electric locomotive is 25 miles an hour. Ultimately, the trains will follow each other at three minutes intervals, but at the commencement of the traffic they will start about 7:30 a. m., and run every five minutes. The stations are lighted by gas; and for the water supply of the steam boilers which is taken from the water company's mains, there are two large tanks, one of 12,000 and the other of 25,000 gallons, as a reserve.

A "COMMERCIAL CABLE" FEAT.

THE Commercial Cable Co., of this city, has issued a tasteful reprint of an article from the San Francisco *Daily Report* of Sept. 27, 1890, showing how rapid had been the transmission by Commercial Cable, United Press and Postal Telegraph services of the news to Frisco of the Slavin-McAulliff prize fight in London. Owing to the speed attained, *Daily Report* extras were selling in the streets with a full account of the fight in just 17 minutes from the time of the dispatch of the final bulletin from London.

TANNING BY ELECTRICITY.[1]

BY A. BIGAUT.

An industry in which it would hardly be expected that electricity is designed to play a prominent part is that of tanning, yet the remarkable results which have been obtained leave little doubt in our minds that the electric current will soon be employed in this field on a large scale. The main object in applying electricity to tanning is to diminish the time heretofore required to convert the raw hide or skins into merchantable leather, a result effecting a reduction from several months to as many days. This is, of course, accompanied by an enormous saving in money in the interest on the value of the skins under treatment. At the present time two important tanneries are now working the electrical process; one of these, operated by MM. Brion and Dupré, in Paris, has been at work for over a year, while the other, the British Tanning Co., has been in operation for several months in London.

The application of electricity to tanning is not new. As far back as 1850 a currier by the name of Crosse invented a process in which he applied electricity. He was followed by A. Ward, of Lancashire, in 1860, who modified the Crosse process somewhat. And in 1861, in Paris, M. Rehn also attacked the problem. The role which he attributed to electricity in tanning was that under the influence of the electric current traversing the solution, the skins were opened and their tanning thus effected more rapidly.

In 1874, M. de Meritens also elaborated a process of electric tanning by which he was able to tan skins in 35 days, and this system is still employed in a tannery near St. Petersburg, having over 600 vats. Lucien Gaulard and Kresser also devised a process of this nature.

In 1887, MM. Worms and Balé, of Paris, invented a rapid tanning process by means of electricity. Their experimental factory, opened in 1887, was operated without much attention being paid to it for two years at Saint-Remyles, Chevreuse sur l'Yvette. The factory is said to be in commercial operation now.

1. *La Lumiere Electrique.*

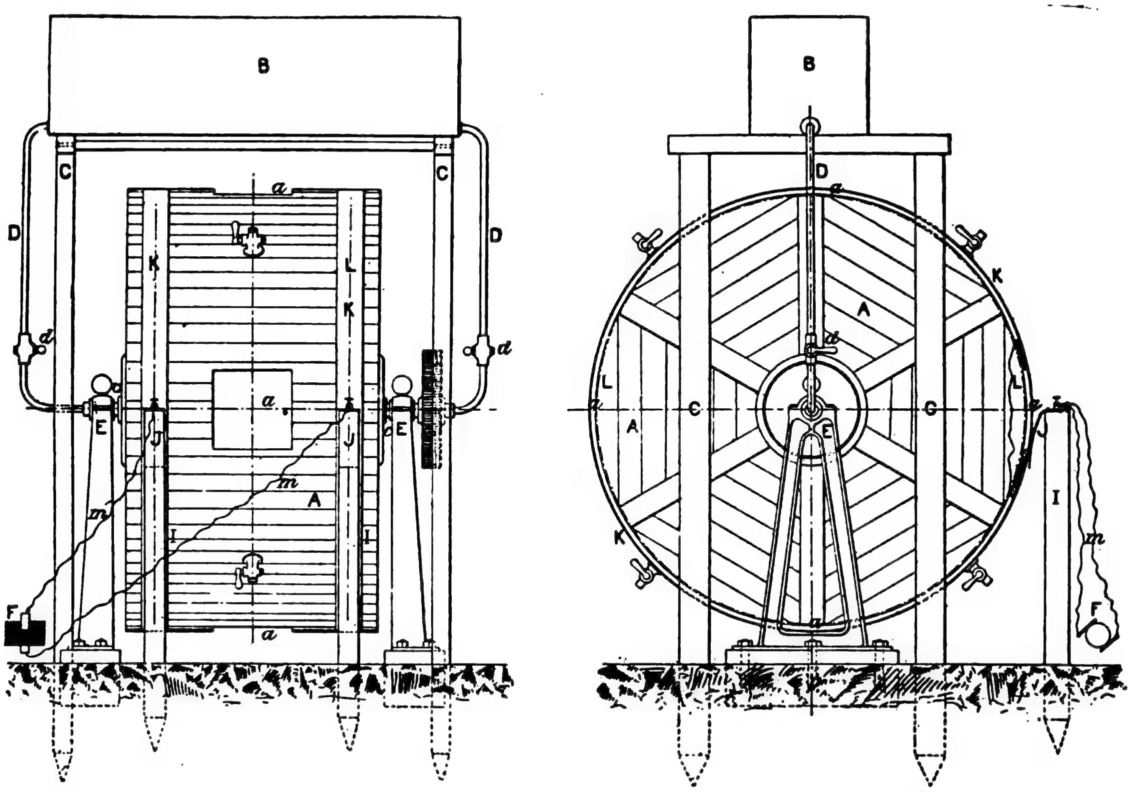
It is this process which is employed in the Paris tannery above mentioned, and in another at Bermondsey. Within a short time a large tannery will be put in practical operation at Longjumeau.

The Worms and Balê process differs from all preceding. In principle, it depends upon the fact that the tanning can be expedited:

First, by the agitation of the skins in contact with the tanning liquor;

Second, by the circulation of the electric current within the body of the liquid. This second fact had already been demonstrated by former trials, while the first is a well known method in tanning. It is the combination of these two processes which constitutes the originality and which ought *a priori* to increase the speed of tanning; and this has been demonstrated to be the actual fact.

The apparatus of MM. Worms and Balé, which permits of the combined agitation and action of the current, consists of a circular drum shown in the accompanying illustrations, Figs. 1 and 2, 13½ metres in diameter and 2½ metres deep, having a capacity of 1200 litres. The interior of the drum is provided with wooden pegs 30 cms. apart and 8 cms. in diameter, and 20 cms. long. The drum is also provided with four man holes *a*, closed by iron bars. The discharge cocks are placed between the doors.



Figs. 1 and 2.—The Worms and Bale Electric Tanning Apparatus.

Placed horizontally above the drum there is a large trough B containing 4,000 litres, and designed to hold the solution. At each end of the trough there is a tube which is connected with the large tube D which leads to the centre bearings of the drum so that the liquid can be introduced into the drum by the opening of the cocks *a*.

The electric current from the dynamo indicated at F is conducted by wires to two pillars I I on which two copper springs J J are fixed. These springs rub against two rings K K which entirely encircle the drum and to which are connected the electrodes L L. These constitute a pair of rings on the interior of the drum which encircle it in the same manner as those on the outside. The circuits can also be arranged to make the current pass from one bearing to another instead of by way of the rings.

In the establishment at Paris there are four drums arranged in the manner just described working continually. The dynamo employed is of the Gramme compound type. The voltmeter and the amperemeter are placed in circuit, and by means of a switch the direction of the current is changed every twelve hours so as to act equally on the electrodes. The above wires are slowly oxidized, but the renewal of the wires or copper bands is necessary only after a large number of operations.

The skins are prepared in the ordinary way, the hair taken off by lime, and they are then put into the drum with the tanning solution made of oak bark extract, and indicating 30° or 40° by the tan-hydrometer (3° to 4° Baumé). The drum receives 500 to 700 kilograms of skins and 1200 to 1500 kilograms of tan liquor, to which is added a little essence of terebenthine.

The drum is rotated at moderate speed while the current of the ampere meter is passed through at an E. M. F. of about 70 to 100 volts. The skins are subjected to the rotating movement, and the wooden pegs prevent them from attaching themselves to the inside of the drum ; and when they are raised to nearly a vertical diameter, they fall and are thus knocked about and beaten continually. During the operation the solution becomes deprived of the tannin, which is fixed in the skin. It is sometimes necessary to add new solution in order to bring the liquor back to its proper strength.

The rotation and electrolysis are continued from two to six days, according to the nature of the skin to be tanned. Goat and sheep skins only require about 24 hours for complete tanning. Calf skins require 48 hours, while cow, steer, and horse hides require from 72 to 96 hours, accordcording to their texture. During the operation the temperature increases but hardly ever passes 30° C.

As the drum is tightly sealed, a safety valve seems to be necessary to prevent an increase of pressure in the drum ; this has been provided in a very simple manner, but the pressure at any rate is only very small.

Thus in four days an operation is completed which ordinarily required 7 to 8 months, and which has been made possible without the addition of acid, and by the simple application of a physical agent which seems to introduce into the skin no other element than tannin. The results have shown that skins so tanned are not only stronger than those tanned by the old process, but that they gain considerably in weight by the process, while by the ordinary method the original weight is very little, if any, increased.

The operation which takes place may be considered to be, that the skins constitute the electrodes upon which the gases disengaged act. As pointed out by Prof. Silvanus P. Thompson, they are porous electrodes, susceptible of absorbing the gases produced by electrolysis. During the operation the liberation of gas is insignificant, so that the hides may be considered to act in the same way as the plates of an accumulator.

BREWER'S ELECTRIC RAILWAY CONDUIT.

ALTHOUGH the overhead system of conductors is now employed almost exclusively in the operation of electric railways, indications are not wanting to show that a good conduit system will soon find application in many cities in which public opinion is averse to the extension of overhead wires.

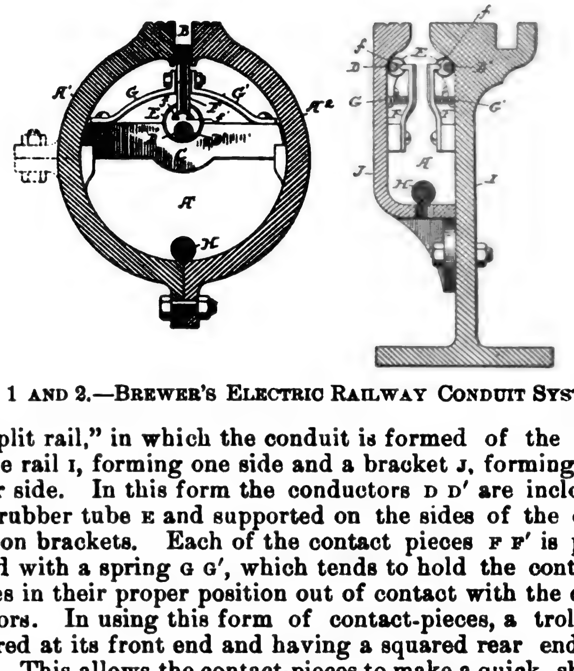
To meet the conditions of a railway conduit system, especially with reference to the thorough insulation of the working conductor, Mr. Wm. J. Brewer, of this city, has recently designed a conduit and method of running the conductors which present several interesting features.

One form of the conduit, which is illustrated in the accompanying engraving, Fig. 1, consists of two cylindrical sections of cast or wrought iron secured together by bolts at the lower end, leaving an open slot B between their upper portions. A brace C, extends across the conduit on the inner side, being connected to lugs. The brace serves to support the conductor.

The conductors consists of two rods D D′, insulated from each other. A single conductor with ground return can also be employed. This conductor is inclosed in a tube of insulating material, E, such as a rubber hose. At regular intervals contact-pieces F are inserted through the rubber tube, and when the conductor consists of two parts this contact-piece consists of two contacts *f f′*, insulated from each other and extending upwards into the slot, the ends being rounded. In order to support this contact-piece in the position shown, the springs G G′, are provided, which are mounted upon the cross-piece and secured to the contact-piece on either side, but insulated therefrom, and these springs normally tend to hold the contact-piece in its elevated position, so that the contacts *f f′* are out of contact with the conductor, except when the trolley arm presses down and effects the contact.

At the bottom of the conduit there is provided a wire rope or chain, H, which is used to clear out the conduit by pulling it to and fro, thereby loosening any dirt or rubbish which may fall in it and assisting its discharge from the conduit.

In Fig. 2 the same idea is applied to what may be termed



FIGS. 1 AND 2.—BREWER'S ELECTRIC RAILWAY CONDUIT SYSTEM.

a "split rail," in which the conduit is formed of the web of the rail I, forming one side and a bracket J, forming the other side. In this form the conductors D D′ are inclosed in a rubber tube E and supported on the sides of the conduit on brackets. Each of the contact pieces F F′ is provided with a spring G G′, which tends to hold the contact-pieces in their proper position out of contact with the conductors. In using this form of contact-pieces, a trolley, tapered at its front end and having a squared rear end, is used. This allows the contact-pieces to make a quick, sharp break of contact and prevents the establishing of an arc after the trolley has passed.

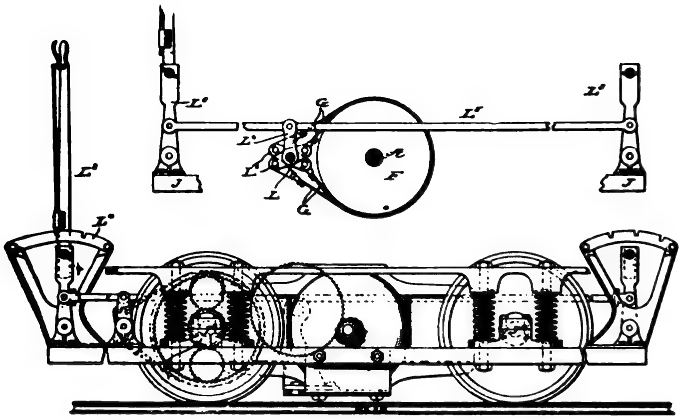
From the above description it will be obvious that the motor on the car obtains its current from the contact at the point where it happens to be at that instant ; and as the motor moves along, one contact is made and the other broken behind it. In this way the line remains completely insulated so that even a complete flooding would entail no leakage of current.

THE POWER PUBLISHING CO.

The above company which publishes *Power-Steam* has been compelled by the growth of its business to remove to new quarters, and it has accordingly located itself in the new *World* building on City Hall Square and Park Row. The company state that their subscription list for November is the largest on record, being the result of a steady and permanent increase, while the same onward tendency is shown in the advertising pages. Such an admirable paper deserves all its success. It is conducted with conspicuous enterprise and ability, and the practical nature of its interesting, well written articles renders it of the utmost value to all engineers who have in any way to deal with power problems or the handling of power machinery.

BELDING'S ELECTRIC RAILWAY CAR GEAR.

The difficulty of overcoming the heavy rush of current which occurs when an electric car is started from rest to motion has given rise to a variety of mechanism, the ob-



FIGS. 1 AND 2.—BELDING'S ELECTRIC CAR GEAR.

ject of which is to maintain the motor in constant rotation and to provide gearing for transmitting the motion of the armature in a gradual manner to the axles of the car. The problem has also been attacked by Mr. Warren S. Belding, of the Belding Electric Motor Co., of Chicago, who has recently patented the gear illustrated in the accompanying engravings. This consists of a sun and planet combination, by means of which the motor is kept in continuous operation, whether the car be moving or not, and which allows of reversing the car with the same continuous motion of the motor armature.

The manner in which this is accomplished will be readily understood. Supposing power to be constantly applied to the wheel C, in the same direction, then the wheel, the

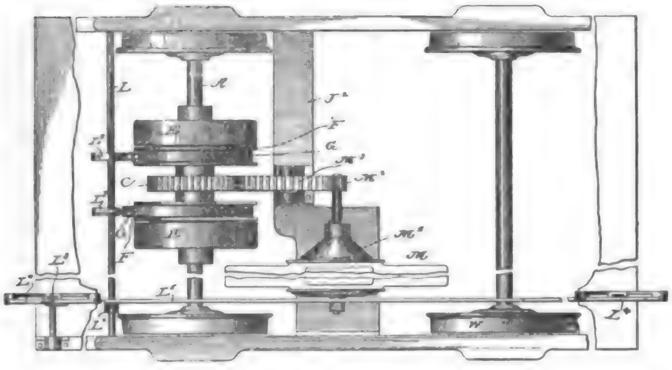


FIG. 3.—BELDING'S ELECTRIC CAR GEAR.

sleeve B, and both spur-wheels D D will rotate in unison without change of direction. The spur-wheel in the member of the mechanism at the right will rotate the wheels F² in an opposite direction, and since the latter mesh into the internal gear of the weeel E, the latter must be turned by the spur-wheel F², or the wheel E must offer sufficient resistance to cause the wheel F² to travel upon the internal gear and through the band-wheel F upon the sleeve B. When the brake-strap G does not engage the wheel F, the resistance of the latter is so small as to allow it to turn upon the sleeve B in response to the force exerted by the wheels D and E; but when the brake-strap G is drawn the wheel F is held rigidly and the wheels F² are no longer free to revolve around the internal gear of the wheel E. Consequently the wheel D acts directly upon the internal gear of the wheel E through the wheels F², thus rotating the wheel E and also the axle A.

Supposing the wheels C and D to be rotating in the direction indicated by the arrow in Fig. 5, then the wheels F² will rotate in the opposite direction, and the periphery of the latter will carry the wheel E in the opposite direction also, and since the wheel E is keyed to the axle A the latter will also be rotated in the direction opposite to the direction in which the wheels C and D are rotated. Looking at the gearing of the second member of the power-transmitting mechanism from the same direction, Fig. 6, it will be seen that the wheel D will rotate the wheel F³ in an opposite direction, while the latter will rotate the wheels F² in the same direction, and that the latter will not rotate the wheel E and axle A in the same direction as the direction in which the wheels C and D rotate. It is apparent, then, that the axle may be at rest while the wheel C is running in response to the extraneous power applied to it, and that if it is desired to rotate the axle and propel the car in one direction one of the band-wheels, F, is engaged, and that if it is desired to rotate the axle and propel the car in the other direction the other brake-wheel is engaged.

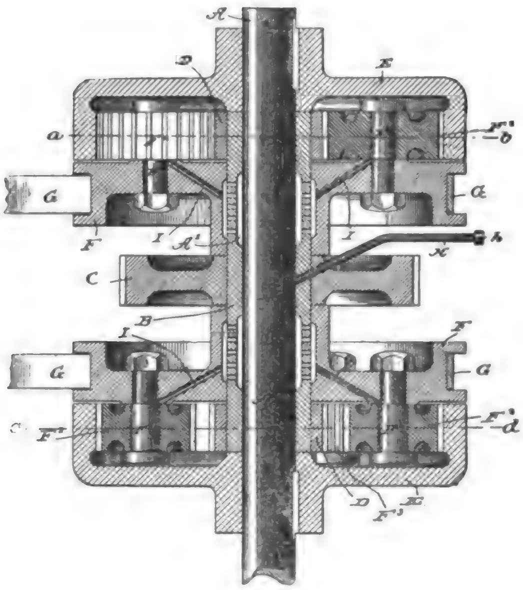
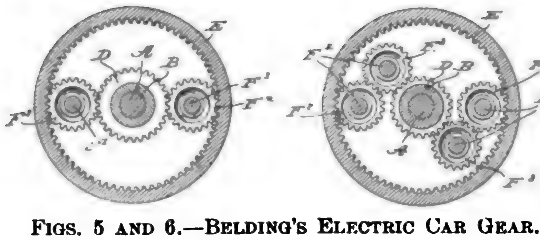


FIG. 4.—BELDING'S ELECTRIC CAR GEAR.

The ratio of the speed of the wheel C and the axle may be varied by varying the relative size of the wheels D and E.

Besides its function of driving the car, the motor may, in an emergency, be used also for braking it, so as to secure a sudden stop. This may be done by quickly reversing the lever L³, so as to apply the power of the motor against the motion of the axle. When the regular course of the car is in only one direction, the duplex mechanism is useful in quickly stopping the car, or in backing it; but when the regular course of the car is in only one direction the two members of the power-transmitting mechanism may be made to operate in the same direction, but at different speeds. Then one or the other of the members of the mechanism may be used, according to circumstances.



FIGS. 5 AND 6.—BELDING'S ELECTRIC CAR GEAR.

When there is a heavy load or a steep grade, the member of the mechanism giving the greater power may be used, while on a level or with a light load, the member of the mechanism giving the greater speed may be used.

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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers*

VOL. X. NEW YORK, NOVEMBER 26, 1890. No. 134

There is one radiant energy, which appears to us as "actinic," or "luminous" or "thermal" radiation, according to the way we observe it.—S. P. Langley.

ELECTRICITY IN MILL WORK.

IF it were not for the fact that so much of the energy of electrical engineers available in the motor department were devoted to questions of street car traction, we should see more attention paid to the great opportunities now presenting themselves in mill work for electric power distribution. The matter must, however, soon force itself upon the consideration of engineers, and we do not hesitate to assert that within two years the complete equipping of mills with motors will be one of the largest and most active fields of electrical work.

Such instances as already come under notice are very encouraging. In a recent address before the Boston Society of Civil Engineers, Capt. Eugene Griffin described a mill or factory plant where it had been estimated by competent engineers that with belting and shafting in the ordinary way from 30 to 50 h. p. would be required; and 15 h. p. additional was necessary for lighting. But, as an actual thing, the motors are delivering about 50 to 70 h. p., though the energy developed runs an average of only 17 or 18 h. p. for ten hours, owing to the immediate adjustment of the generating plant to the load, and the absence of long lines of idle shafting to be driven. A still more striking example has just come to our knowledge, worthy of widespread publicity. About a year and a half ago the Globe Tobacco Works in Detroit were furnished with an installation of seven Eddy motors; another has lately been added. The motors vary from 1 up to 15 h. p., and they aggregate 57 h. p. It appears that as the result of this equipment, in which the motors have been placed exactly where the power was wanted, and, as usual, under onerous conditions, the Globe Company are saving, according to their own statement, about 20 h. p. over the old style of transmission by shafting and belts. Nor is this all, for they say that they are lighting their factory, a large building, with incandescent lamps, at no perceptible additional expense. It may be remembered by some of our readers that in this installation it was ingeniously arranged that, if desired, the plant could switch its surplus current into the street incandescent mains, and while we are not aware that the plant has ever been called on to do this, the point should not be overlooked.

Here, then, we have an installation of 8 motors of not quite 60 h. p. with which a saving of 20 h. p. is cheerfully admitted by the users, while the lighting is, so to speak, "thrown in," and the attention and repairs are a minimum. Too much prominence cannot be given such cases as this as an example of what electricity can do for the mill. If this can be done in one mill or factory, it can be done in another.

According to figures accredited to a New England cotton mill engineer of high reputation, eight modern mills, with first-class shafting, showed an average per cent. of 28.7 of the horse power of that required for the whole load to be used by the shafting. In one instance, to drive the shafting alone took 36.1 per cent. of the whole horse power and in another 39.2. These are remarkable figures. With motors simply located so as to drive short independent lines of shafting on each floor, part of this waste would still have to be endured; but there is often the choice of coupling the motor directly to the machine it is to run.

It has long ceased to be a novelty for mills and factories to employ the electric light, and where they have the apparatus for the one service it should be easy to introduce the other. A singular episode occurred a month or two ago in an English mill, where, the regular motive power having broken down, one of the lighting dynamos was driven by its fellow as a motor, and being belted to the shafting kept the mill in operation. Perhaps incidents of this kind will help arrest attention on the flexibility of electrical distribution; and when there is added the economy illustrated so forcibly by the Globe Tobacco Works, the universal resort to electric power for mill work is not likely to be long delayed.

ELECTRIC TANNING.

THE number of arts in which electricity is now being brought into play as a useful adjunct is increasing at a rate which makes it evident that before long the electrical engineer will be a necessary and permanent employé of most manufacturing establishments. The marvels which electricity has already accomplished in the domain of metal working, are well known, and only recently we recorded the result of the greatly increased yield in agricultural products cultivated on ground through which the electric current had been passed. We were, therefore, thoroughly prepared to give credence to the remarkable results recently obtained in the tanning of leather by the

employment of the electric current. The new process, which we describe in another column, is based on sound theoretical principles, and the results obtained are, indeed, just what might have been expected. We have before us the results of tests recently made in this country, in which the process is about to be introduced, which show that, with the process of Messrs. Worms and Balé, 919 pounds of hides gave 1,278 pounds of leather in four days. The tests also show that 1,042 pounds of hides, subjected for the same length of time to the action of the revolving drum, but without the presence of the electric current, gave only 1,210 pounds of partly tanned hides. The saving in time possible by the new process, as well as the gain due to increase of weight, are evidently factors of great economical importance, and would appear to be sufficient to warrant the adoption of the process.

The daily press, in recording the new applications of electricity, as a rule, welcomes them as a new source of employment and profit, or of comfort to many. We therefore noted with surprise the appearance last week, in the New York *Herald*, of an article in which it was sought, in a clumsy way, to cast ridicule upon the new process, and in which the conclusion arrived at is, that the same results can be obtained in the four days, without the use of electricity. It is needless to point out that if such were the case, our enterprising tanners would hardly be likely to let hides lie in the vats for seven months when four days will suffice to accomplish the desired object. Our contemporary is usually accurate in its treatment of technical questions and it cannot afford to oppose with sneers and abuse well established facts, the force of which must make them felt in spite of opposition. We hope that the new process will receive a thorough trial in this, the greatest leather producing country in the world, and thus add another to the applications of the current that now greet us at every turn. We may add that we have carefully inspected the leather ourselves and have had it examined by experts of the highest reputation. It is impossible to resist the belief that the process is destined to be one of the greatest factors in modern tanning.

ELECTRICAL TESTING.

The history of the first twenty years of telegraphy in this country is one remarkable alike for the rapidity of growth of the industry, as well as for the impediments which beset it during that time. It will be within the memory of many of our readers that, in 1869, shortly after the accession of Mr. Wm. Orton to the presidency of the newly consolidated Western Union Telegraph Co., the services of Mr. C. F. Varley, the eminent English electrician were called on to bring order into the electrical chaos which then existed in the telegraph system. The results of Mr. Varley's investigation showed that one-half the wires on this continent were practically useless and that the office apparatus was of such a character as to seriously reduce the efficiency of the service.

It goes without saying that this deplorable state of affairs was due almost entirely to a lack of systematic testing, and the introduction of the latter in this country was immediately followed by a succession of brilliant improvements, as well as an enormous economy in operation.

While the lesson taught those in the telegraphic field has been well heeded, it was, unfortunately, forgotten or never heard of by many of the pioneers in the later fields of telephony and electric lighting; and it required the severe school of experience to teach these again that true economy can only go with a definite knowledge of the condition of the service, and that this can only be attained by systematic and continuous testing.

As a result of this, we have been glad to note the addition to the staff of numerous electrical companies of men charged with the electrical supervision of lines and apparatus, which had heretofore been allowed to run along in an uncertain way until early and very premature total failure made their renewal imperative. But there is still much room for improvement in this respect and many a position where a competent electrical engineer will find work cut out for him, and hence it is well for those who wish to become fitted for it to acquire the necessary training and skill.

It is with this object in view that we have begun an illustrated series of articles on practical methods of testing insulated wires and cables from the able pen of Mr. Herbert Laws Webb. Being himself actively engaged in the work he describes, Mr. Webb is able to place before his readers the practical methods used in everyday working, designedly leaving on one side the more refined and special methods which are, indeed, but seldom employed out of the laboratory. As Mr. Webb points out, the carrying out of such tests involves no great difficulty when the apparatus is properly set up and adjusted, and it is with the object of imparting such information as well as describing the methods of manipulation that the articles which we began in our last issue have been prepared.

The Artificial Light of the Future.

The superiority of the electric light, looked at from the standpoint of efficiency, is undisputed, but the fact still remains that the actual energy required to produce a given amount of light is far in excess of that theoretically necessary. How to diminish this disproportion has been the subject of much speculation, and the nature of the problem is admirably presented by Prof. E. L. Nichols in the paper read by him last week before the New York Electric Club. The present limitations of carbon as the light-producing medium are well defined, and other substances capable of withstanding high temperatures are brought forward. As Prof. Nichols remarks, "luminescence" by heat can never give us the best results in efficiency, but we believe that by the aid of electrical action in one form or another, results can be obtained more economically and conveniently than with any other method.

Sale of Bell Telephones.

It having been reported that Bell telephone instruments would be sold outright for private lines at $10 only, the American Bell Telephone Co. has positively denied the report. It is characterized as utterly without foundation. The company will, as heretofore, adhere to the system of rental.

LOW SPEED MULTIPOLAR DYNAMOS AND MOTORS FOR CONTINUOUS CURRENTS.

BY FRANK A. PERRET.

THE many practical advantages of a lower rate of speed in dynamo electric machinery have long been recognized, yet until recently few attempts have been made to secure it. The wide-spread use of the electric motor has, however, rendered low speed a feature of great importance, in that it so greatly simplifies the application of the machine to all classes of work, in most cases obviating the necessity of counter-shafting or similar speed-reducing mechanism.

The writer is aware of a prevailing opinion that serious difficulties are encountered in the attempts to manufacture this class of machines on a commercial basis, but believing the difficulties to be surmountable, he devoted several years to a careful study of the subject, with the result that he designed a type of machine in which he believes the desired end is attained without the introduction of any element of danger or the sacrifice of a single feature essential to a thoroughly practical machine.

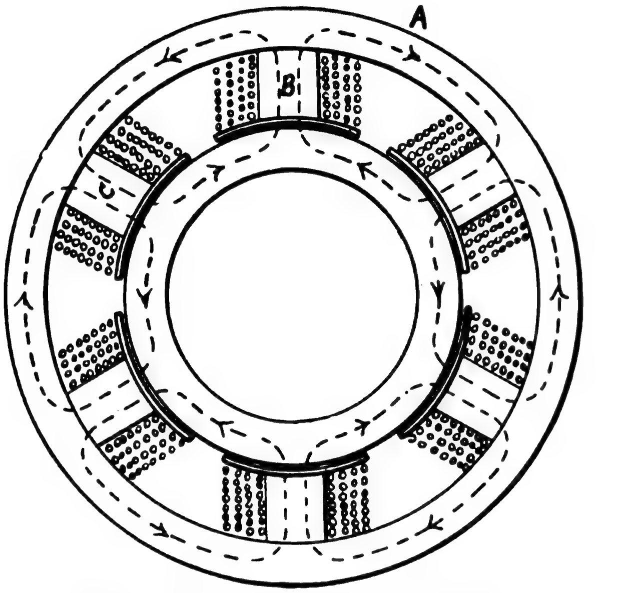


FIG. 1.—ORDINARY MULTIPOLAR FIELD.

In the light of this experience it is proposed to consider briefly some of the principles which govern the action of multipolar machines, and to demonstrate that the obstacles which have heretofore stood in the way of low speed, may be, and have been, overcome.

The prime function of an armature conductor is the generation of an electromotive force, the value of which is proportionate to the number of magnetic lines of force cut by it in a given time. Now, the number of lines cut per second is dependent upon two factors, (1), the total number of lines of force in the magnetic circuit, and (2), the number of times they are cut per second. As our aim is to generate a given E. M. F. at a *lower* speed than is usual, it is evident that the quantities in either or both of the above factors must be increased. In the case of the first we are limited by the saturation point of iron which prevents our indefinitely increasing the strength of the magnetic circuit without adding abnormally to the weight and size of the machine, and even were it possible to do this, an increased exciting current would be required, which would detract directly from the total efficiency. We turn then to the second factor and, paradoxical as it appears at first, it is here we find the solution of the problem. How are we to cause an armature conductor to cut a given number of lines of force a greater number of times per second without increasing the speed? In the ordinary two-pole machine the armature conductor crosses the magnetic circuit and cuts all the lines of force twice during a complete revolution, viz., where they enter the armature core at one pole and where they leave it at the other. Now, if we so dispose the magnetic circuit as to cause the lines of force to enter the armature core at one point, to leave it at another, to *enter it again at a third point and to leave it at a fourth*, it is obvious that the conductor will cut all the lines at four points in each revolution, and that it will therefore generate the same E. M. F. at one-half the original speed. If we increase the number of poles to six, we shall obtain the same effect at one-third the speed, etc., etc. This, then, is the principle of construction by which we secure low speed.

It should be noted that we do not increase the number of lines of force in the magnetic circuit, we do not add to the turns of wire in series on the armature, we do not increase the amount of either copper or iron in the entire machine, but we simply cause the armature conductor to cross the magnetic circuit as often in one revolution as it ordinarily does in two or three revolutions, as the case may be. The writer wishes to emphasize these points as there seems to be some misunderstanding in regard to them. We do not *wind an armature to run slowly*, but we design the machine for low speed. The resistance of our armature is no higher than that of a high speed machine of the same power, its current capacity is not reduced; in fact, as we shall see later, it is increased. The efficiency is no lower, the regulation no less perfect, and the weight and bulk no greater. We see then that in theory the multipolar machine is perfect; consequently if any difficulties have been encountered in its practical operation they must be due to some faults of construction, to a consideration of which the attention of the reader is now invited.

If we take as an example a motor having a six-pole field, and imagine the same in action, we see that the distribution of potential is such as to form the equivalent of three ordinary armature windings on the one ring and connected to the commutator, which has three times as many segments as that of a two-pole machine. Each of these windings, *i. e.*, the wire lying under one pair of poles, has exactly the same number of turns as an armature of a two-pole machine but of smaller wire, and carries but one-third of the total current, the three acting together in multiple. This being the case, any relative difference in the strength of the field magnet poles will cause an unequal distribution of potential and current in the armature. This is, in my opinion, the most important point to be considered in the designing of such machines, as any inequality is sure to cause trouble.

In a bi-polar machine there is but one path for the lines of force, which circumstance insures equal poles, but in the multipolar type, as ordinarily constructed, a variation in the magnetic conductivity of any part of the circuit will cause an inequality.

Fig. 1 represents a form commonly given to multipolar fields. It will be seen that an internal blow-hole, or hard spot, or other imperfection in the casting at A, would choke some of the lines proceeding from B, and they would therefore flow through C, and cause a difference in the strength of the poles. Cast iron should therefore be excluded from the magnetic circuit, there should be no joints, and the number of magnetizing coils should be as small as possible.

Fig. 2 is a diagram of the magnetic circuit of the machine designed by the writer. In this construction there are but three magnets, each being isolated magnetically from the others excepting through the medium of the armature core, and completely isolated from the frame-work of the machine. They are formed of plates of soft sheet iron, which are punched to the required shape and strung together on non-magnetic bolts by which they are secured to their supports. A single magnetizing coil forms two salient poles, and as each magnet is built of a large number of plates a uniform magnetic conductivity is secured. By this method of construction all danger of any inequality in the strength of the poles is avoided, and a magnetic circuit without joints and of the lowest possible resistance is secured. It is understood, of course, that in all cases the number of ampere turns on each magnet must be equal.

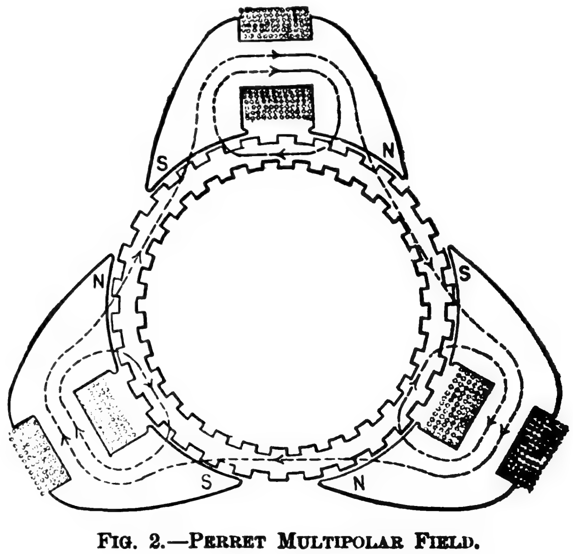


FIG. 2.—PERRET MULTIPOLAR FIELD.

In proportion as we decrease the "feet per minute" we increase the "lbs. raised," or, in other words, the mechanical effort or torque is greater in a low speed than in a high speed machine; extra pains should therefore be taken to secure a substantial mechanical mounting for the armature upon the shaft, and also for

the wires upon the core. The armature is, therefore, built up on eight insulated steel bolts, the ends of which are secured to non-magnetic spiders, which in turn are keyed to the shaft. The wires are wound in longitudinal channels on the periphery of the armature core which holds the coils rigidly in place and entirely prevents that minute shifting of the wires which certainly is the cause of so many "break downs" and "burn outs" in armatures. The driving force in a motor and the resisting force in a dynamo is exerted by the armature conductors, and we should always provide a positive mechanical connection between them and the core; friction does not suffice. The importance of this point is fully understood by Kapp, who writes: "In many machines the friction produced by the binding-hoops is alone relied on to carry the wires through the field; but experience has shown this to be insufficient. Even if the wires are not bodily torn off the armature by the magnetic resistance of the field, they shift and work on the surface of the core; and it is only a question of time when the insulation will be destroyed, and the machine break down."

We have a choice of two methods of coupling the armature circuits together in multiple, one of which is by the use of six brushes distributed around the commutator 60° apart, three negative and three positive, and the other consists of a system of cross connections in the armature or commutator which connects those coils which are simultaneously undergoing the same induction; these in a six pole machine are situated 120° apart. By this means a single pair of brushes suffices, and these bear on the commutator at points diametrically opposite, exactly as in a two-pole machine. This method is preferred when copper brushes are used, and I have in use a simple system of cross-connections at the back of the commutator, in which all danger of short-circuiting is avoided; but the carbon brush is so peculiarly adapted to the method first described that it forms one of the simplest and most reliable means of commutation that can be devised. The high resistance of the carbon brush, as ordinarily constructed, has prevented its universal adoption, but the construction of this machine permits the use of three pairs of brushes, each pair carrying but one-third of the total current, and the resistance is greatly reduced by reason of the increased contact surface.

In a two-pole machine the armature current is divided equally between two circuits, while that of a six-pole machine splits into six. This the writer considers in most cases an advantage, as the current carrying capacity is increased by reason of the greater surface exposed to radiation, and the machine will consequently bear a greater overload without injury while the wire is not so large as to be unmanageable. In many machines of the two-pole type a stranded armature conductor must be used, because a single wire would be too stiff and would heat too much; in a multipolar machine these troubles are avoided.

A great deal has been said and written in respect to the difference of potential that should be allowed to exist between adjacent commutator segments, some writers having advanced erroneous opinions on this point to the disparagement of multipolar machines. One tells us that 10 volts should be the limit because "10 volts will just form an arc," while another puts the limit at 19 volts and gives the same reason.

Now, an arc has to be started or "drawn" and the only time this can happen is when the brush connects two adjacent bars as they pass under it. But this only takes place at the so-called neutral points where the difference of potential between adjacent bars is almost nothing. Theoretically this difference of potential is simply the product of half the total current and the resistance of the coil connected to the two bars. We see, therefore, that we should not take for a basis of calculation the *average* difference of potential between adjacent bars, for the reason that the E. M. F. of each coil is continually varying from zero to maximum and down to zero again. A very clear description of this action will be found in the fourth chapter of S. P. Thompsons' "Dynamo Electric Machinery," together with the methods used in determining it, and I commend a perusal of this to the writers referred to.

In a machine wound for 220 volts and having 22 coils acting in series, we do not find a uniform difference of potential of 10 volts between adjacent commutator bars, but those coils which are passing the poles are generating 15 or 20 volts, while those in the neutral zone are generating practically nothing. In some of the most widely used closed coil machines in this country the average difference of potential between adjacent segments is far greater than the limits given by the above mentioned writers. In one of these it is 27 volts, in another 50 volts, and in others it is still higher, yet these machines give no trouble whatever. Let me not be understood to favor the use of a small number of commutator's sections, I simply wish to show that no one is limited to 10 or to 19 volts, average potential difference between adjacent bars.

In the machines of my own design, which I have partially described, the number of sections in the commutator is 96, of which 16 act in series. At an E. M. F. of 220 volts they average, therefore, 13¾ volts each and at 500 volts total E. M. F. they will average 31¼ volts.

As bearing upon some of the statements which I have made, I present the following details of my 10 and 20 h. p. machines, which fairly represent them all:

10 h. p. 220 volt motor.
Speed, 600 revolutions per minute.
Weight, 900 lbs.
Resistance of armature, .19 ohm.
Resistance of shunt, 175 ohms.

20 h. p. 110 volt dynamo (compound).
Speed, 600 revolutions per minute.
Weight, 1,300 lbs.
Resistance of armature, .029 ohm.
Resistance of shunt, 26 ohms.
Resistance of series coil, .007 ohm.

It will be seen that a low speed multipolar machine is not necessarily a heavy one, but that on the contrary it may be made very light. The writer has recently built several 25 h. p. series wound motors which weighed 1,300 lbs. each and ran at a speed of 500 revolutions per minute. If one of these were so wound as to run at 1,000 revolutions per minute, it would develop 50 h. p. and weigh only 26 lbs. per h. p. For traction purposes these motors are designed to run as slow as 450 revolutions per minute and weigh about 70 lbs. per h. p.

In regard to their practical operation, I will simply say that the first machines which were constructed a year ago have been in constant and satisfactory use ever since, and they have proved themselves to be in every respect the equals of the high speed machine.

ON THE THEORY OF COMPOUND WINDING FOR CONSTANT POTENTIAL.[1]

BY DR. LOUIS BELL.

I wish to preface this paper by stating that there is in it nothing revolutionary, nor any radically novel attempt to treat a problem that has already been handled by more skillful hands than mine. It is simply an effort to bring the theory of compound winding to a practical basis, indulging in no complicated formulæ and introducing no constants that cannot be conveniently determined in practice. To this end I shall consider the subject synthetically rather than analytically, starting from the plain shunt winding and considering those terms which must be introduced to take account of the failure of shunt winding to give constant potential. I do not think that compound winding should be considered as anything more than a method of improving a shunt machine already well designed; it should certainly never be called upon to avoid the evil effects of bad design.

For the systematic treatment of the subject I would introduce the following notation, which differs slightly from that most often employed, but is convenient for the purpose in hand.

Let C_x, represent the current on the line;
C_s, the curret in the shunt coils;
R, the resistance of shunt coils;
r, the resistance of armature and series coils combined;
E, the E. M. F. of the machine running light;
e, the fall of potential due to armature resistance;
N, the number of convolutions in shunt coils;
n, the number of convolutions in series coils;
m, the number of convolutions on armature;
a, b, c, the three terms of n;
l, the angle of lead;
q, the magnetic resistance of machine on open circuit;
q_x, the magnetic resistance of machine at full load, and
p, the value of q_x divided by q.

I shall consider especially the long shunt arrangement, though, as will be seen later, the short shunt leads to practically the same results.

The first and obvious cause of fall of potential at the terminals of the machine is due to the fact that the armature has a resistance; as the current increases a certain amount of potential is absorbed in the armature, and consequently the available E. M. F. at the terminals fall. The amount of decrease is evidently proportional to the resistance in the armature and the current through it

$$e = r\,C_x\,.$$

To compensate this loss we must furnish an increase of induction sufficient to produce e additional E. M. F. If the field magnets and the armature core were quite unsaturated, that is, if we could neglect the change in permeability, we should simply increase the total ampere-turns to an amount sufficient to compensate the fall in potential. Let a be the series turns capable of producing this at full load, neglecting change in permeability, then

$$a = \frac{Nr}{R}\,,$$

But the permeability decreases as we put on this additional induction. The magnetic resistance, q at the start, will have increased to a certain other value q_x. We must therefore increase

1. A paper read before the American Institute of Electrical Engineers, New York, Nov. 18, 1890.

the number of series turns to take account of this added resistance, and we have

$$a = \frac{Nr}{R} p.$$

It will be observed that this quantity does not have to be multiplied by the coefficient of leakage because we have simply reduced the shunt turns to equivalent series turns, and consequently have already included it. This formula will be at once recognized as practically equivalent to that given by Thompson in his well-known book, and at this point Thompson drops the investigation, merely mentioning incidentally some of the other causes which necessitate compounding. Thompson's formula:

$$\frac{Z}{S} = \frac{r_s}{r_s + r_m} \times \frac{q_1}{q_0}$$

is not quite the same as mine for the reason that while his q_0 is proportional to the permeability when there is no external current, his q_1 is proportional not to the permeability at maximum current, but to the mean permeability between no load and full load. Hence if Z is taken as the number of shunt turns required to give the desired potential on open circuit, Thompson's formula will inevitably give too few series turns for the reason just mentioned, if for no other. But since by adding series turns the magnetic resistance is increased the shunt winding which produces E volts on open circuit will not do so at full load. Additional series turns must then be employed to compensate for this and since the change in shunt ampere-turns must be from NC to NCp, the number of series turns to be added to compensate for the decreased effect of the shunt will be

$$b = \frac{NE}{R}(p - 1).$$

This term also includes C_s coefficient of leakage for the same reason as before.

It will be noticed that both a and b include the quantity p, and here is met the principal difficulty in affecting the compounding. It is my purpose to show that this quantity p can be obtained from known data with sufficient accuracy for the purpose in hand. It will evidently be a quantity little in excess of unity and in practical machines may range from 1.05 to 1.50, although in certain cases it may even exceed the latter figure. Thompson gives the case of a certain Siemens compound machine in which p would be over three. This, however, must have had a very insufficient amount of iron in the magnets or the armature core, or both. We fortunately do not have to deal with dynamos of such bad design very frequently. Provided we have known enough about the iron to be used in a given machine to design the shunt winding intelligently, we shall also know enough to design the compound winding. If we have at hand the characteristic curve of a similar shunt machine p can be determined very easily from it. I give herewith the data for the Manchester machine described by Dr. Hopkinson. I have simply taken the apparent permeability from his characteristic curve.

When magnetizing force	equals	1,000,	$\frac{\text{induction}}{\text{magnetizing force.}}$	equals	470
"	"	"	2,000	"	"	465
"	"	"	3,000	"	"	460
"	"	"	4,000	"	"	460
"	"	"	5,000	"	"	460
"	"	"	6,000	"	"	451
"	"	"	7,000	"	"	443
"	"	"	8,000	"	"	425
"	"	"	9,000	"	"	400
"	"	"	10,000	"	"	377
"	"	"	11,000	"	"	353
"	"	"	12,000	"	"	333

If the permeability curve of the iron is known even approximately we can obtain p from it quite readily. In Plate 1, let a b be the permeability curve. The permeability at no load corresponds to the point d, that at full load to the point f. Now lay off the ordinate d e so that the ratio between d e and c d equals the ratio between the iron resistance and the air resistance of the proposed machine, then lay off from the point f the ordinate f g equal to d e, and draw g h. Then the ratio of the lengths h c and e c corresponds to the quantity p required. Plate 2, drawn from Hopkinson's figures, gives numerically the change in permeability for cast iron. The figures relating to the Manchester machine were, of course, for wrought iron cores and cast iron poles. It is thus evident that a rather close approximation to the value of p can be made if we know anything about the iron that we are going to use. Now as we shall see later, and as is indeed evident at the start, a and b are of about the same order of magnitude. I do not think that b will ever be negligible in a practical machine unless a is also negligible, and there is, therefore, little need for compounding. When the magnets are anyway near saturation b will be much larger than a, but both a and b combined will not give the proper number of series turns for constant potential unless the armature is run with no load, and therefore produces no demagnetizing effect. The approximate damagnetizing effect of the armature has been investigated by Hopkinson and is as follows:

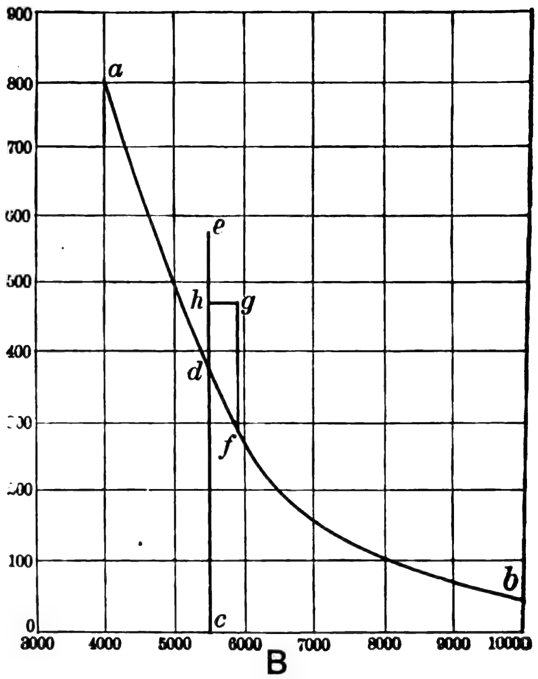


Plate 1.

$$4 n \bar{C} \frac{m}{2} \times \frac{2l}{\pi} = 4 l m C.$$

In other words, it is due to the convolutions included in twice the angle of lead. For constant potential we must add then c turns in series equal

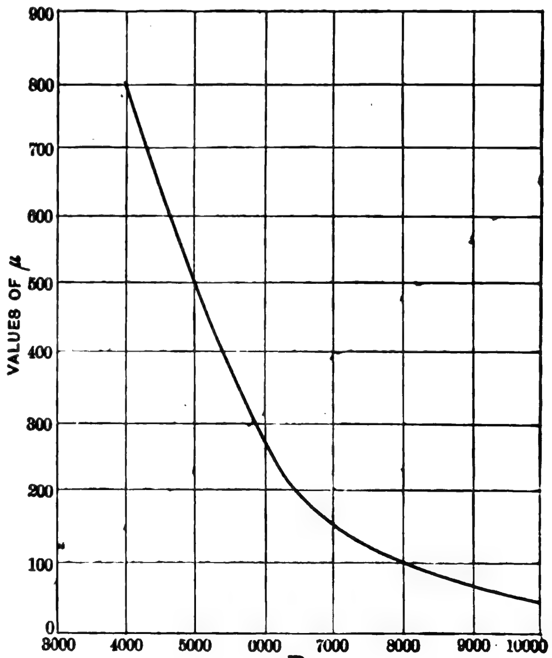


Plate 2.

$$v m \frac{l}{\pi}.$$

It is evident at once that a change in lead will effect the compounding; an increased load will cause the machine to under-compound, a decreased load to over-compound. As, however, the amount of distortion in the field depends largely on the shape of the extremities of the pole pieces, the above uncertain factor in

shunt is allowed to increase, the change in resistance will decrease the relative power of the series coils, and the machine will under-compound.

It now only remains to glance at some of the formulæ heretofore given. That of Thompson I have already incidentally discussed. That of Frölich (perhaps the best we have had) should receive mention here. Frölich takes account of the change in permeability by introducing a quantity f. Like Thompson, his formulæ involve two pints of saturation. It should be said here that there is no special black magic about the half saturation point of a dynamo, any more than about the three-sevenths or the seven-thirteenths saturation point. In very many cases it happens to be about the point at which the machine is used. Kapp, in his well known and excellent book, takes account of the change in permeability with a fair degree of approximation, by the use of his tangent function.

All these attempts at the proper theory of compounding depend, like the one which I have just presented, on forming some sort of an estimate on the change in magnetic resistance of a dynamo, due to adding a certain amount of induction. Without some approximate method of finding this quantity, the problem is indecompounding can often be gotten rid of by a little care in designing the poles.

It is obvious that the term c is to include the coefficient of leakage. Uniting now, the three terms, a, b and c, we have finally, as the completed formula for compound winding, the following:

$$n = p\,\frac{Nr}{R} + \frac{\frac{NE}{R}(p-1)}{C\,x} + v\,m\,\frac{l}{\pi}.$$

It now may be interesting to see how well this formula applies to practical machines. I regret to say that I have been unable to get full details of any machine which gave exact compounding, but I have obtained an assortment sufficiently large to show in a general way the applications of the formula.

Machine No. 1, 110 volts, 8 amperes, over-compounded 2 volts. For this small machine take p equal to 1.2. Applying the formula, a equals 14, b equals 44, c equals 15; total series turns by formula, 73; actual number, 90.

Machine No. 2, 110 volts, 3 amperes, over-compounded 3 to 5 volts. a equals 2, b equals 7, c equals 7; total series turns by formula, 16; actual number, 28.

Machine No. 3, 500 volts, 20 amperes. p equal to 1.1, a equals 3, b equals 15, c equals 14; total turns by formula, 33; actual number, 60. Machine over-compounded 3 to 5 volts.

Machine No. 4, 110 volts, 200 amperes, over-compounded 5 volts. p equals 1.05; lead rather large. a equals 2, b equals 2, c equals 5; total turns required, 9; actual number, 12.

Machine No. 5, 500 volts, 60 amperes. p equals 1.05, over-compounded about 7 per cent. a equals 3, b equals 5, c equals 4; total, 12; actual number, 32.

Machine No. 6, 500 volts, 90 amperes. p equals 1.05; a equals 3, b equals 4, c equals 4; total turns should be 11; actual number, 19. Machine over-compounded like the former.

Machine No. 7, 500 volts, 150 amperes. p equals 1.05; over-compounded 7 per cent. a equals 3, b equals 3, c equals 3; total 9; actual number of turns, 28.

Machine No. 8, 100 volts, 30 amperes. p equals 1.1, a equals 13, b equals 46, c equals 25; total 84; actual turns, 56. Machine over-compounded about 2 volts, and the shunt winding did not bring the potential up to the 100 volts intended.

These are merely rough figures, obtained without the use of even the permeability curve of the iron—simply by estimation from permeability curves at hand. It will be seen, however, that all the over-compounded machines got from the formula too few series turns, while the under-compounded machines gave too many. I think that the discrepancy is of about the right order of magnitude, although we cannot verify it accurately without the curve of the iron.

It remains to consider some few further points regarding compounding. If the winding is designed to give the potential at practically no load and at full load, it necessarily follows that at some point between the potential will rise; for, while the magnetizing force changes along a line, the magnetic resistance changes along the corresponding curve between the same points.

An approximate idea of the amount of irregularity in potential may be gained from Fig. 1. Connect in this diagram d and f by a straight line. From its middle point drop an ordinate upon the axis. The length intercepted between the straight line and the permeability curve then gives the error in compounding by comparison with the total change of magnetic resistance.

It should be noted that the formula I have given determines the compound winding for a given assumed potential produced by a shunt coil alone; therefore, if the machine is to be run at a slightly different speed from that at first intended to produce this given voltage, the compounding is still correct, for it pertains to the voltage rather than to the speed. If the speed of a correctly compounded machine be raised and the current in the shunt kept constant, it will tend to over-compound. If the current in the terminate, and the special thing which I have endeavored to show is that from the data already at hand about iron, we can form a sufficiently close estimate of the value of the coefficient p, without either knowing the characteristic of the machine, or indulging in endless approximations. I hope that some practical designer will look into the values that p takes in his machines, and I believe that it can be readily enough obtained to permit of quite accurate compounding, by the use of the formula I have given. The introduction of the terms b and c I regard as important. Their existence has been well known, but I do not think they have received the attention that I have endeavored to show they deserve.

THE ARTIFICIAL LIGHT OF THE FUTURE.[1]

BY PROF. EDWARD L. NICHOLS.

THE growth of electric lighting forms one of the most brilliant chapters in the history of invention. The record is one of which the electrician has reason to be proud. It is a record of advance following advance in our means of generating current and of transmitting it. It is the record of the evolution of the arc lamp from the first crude forms to the perfectly regulated lamp of today. It is the record of the development of the incandescent lamp. Throughout it all we note with wonder that the perfecting of 10,000 details of construction has gone hand in hand with ever diminishing cost of production.

As we review the history of the electric light, however, we

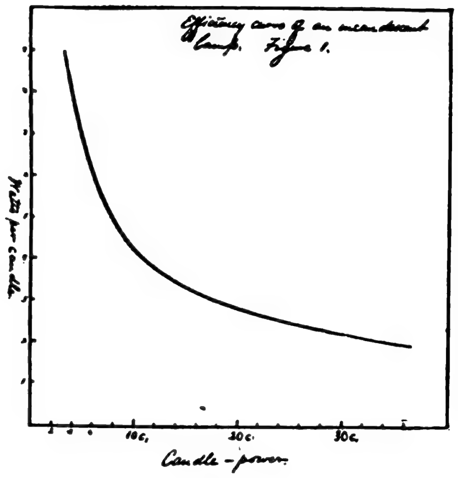


FIG. 1.

find that in two respects there is less cause for congratulation. When we come to consider the quality of the light produced and the efficiency of the apparatus as a light-making machine, we find that the incandescent lamp of to-day produces the same quality of light which the earliest examples of its type were capable of giving. We find, however, that its light differs but little from that obtained by burning oil and gas, which, in turn, in spite of all the improvements which have marked the growth of artificial illumination, is almost the same in quality as that which the Eskimo obtains from the crude blubber of the whale, or which the dweller in the log cabin on the frontier may get from his home-made tallow dip.

It is true that the efficiency of the incandescent lamp has gradually risen from five to three watts per candle, but those who have had occasion to trace the discouraging life curves of such lamps know how little real progress the change implies. We start a well manufactured lamp at any temperature we please, provided that we do not pass a certain limit, beyond which the life of the lamp would be too seriously curtailed. The initial efficiency may be made as large as we please, within that limit; but it is only a question of a few days or hours when the lamp will have dropped to the dead level of mediocrity, the five watt level which seems to mark the confines of permanency in the case of incandescent carbon.

When we take a lamp and raise its electromotive force step by step, measuring the current, voltage and candle-power at each stage of the experiment, and plot the curve which expresses the relation between the energy required and the light produced, we are gratified at the marked rise in efficiency which follows each slight increase in the temperature of the filament. (Fig. 1.) That rise of temperature, however, means shortening of the life of the

1. Read before the New York Electric Club, November 20, 1890.

carbon, is well known. Mr. John W. Howell, in a valuable paper read before the American Institute of Electrical Engineers,[1] has given us abundant data upon that point. Unfortunately, rise of temperature means much more than that. I will venture to show you a few life curves recently obtained in the laboratory of Cornell University. These curves enable us to see at a glance what happens during the curtailed existence of a lamp which is forced to undue brilliancy. I introduce them because they indicate very definitely the nature of the difficulties which confront us when we endeavor to increase the efficiency of an incandescent lamp by raising its temperature.

In the first instance, a lamp was started at the candle-power indicated by the maker, and was held at constant voltage by means of the current from a storage battery. The initial candle-

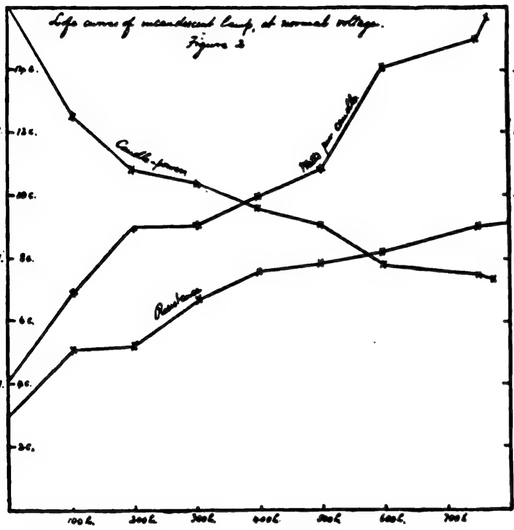


Fig. 2.

power was 16, which was obtained at the expenditure of 3.015 watts per candle. Measurements of electromotive force and current were made at intervals of about 10 hours, during the 800 hours that the lamp lasted. The candle-power was redetermined at intervals of about 100 hours. The voltage never rose more than 0.65 volt above its initial value, and then only for a short time. The average electromotive force of the entire run was 0.40 volt below the initial value. The record of this lamp is contained in Fig. 2. It represents an individual case and not the average obtained from many lamps, but it is typical of the results which have been obtained with many. The characteristic features are rapid, followed by slower falling off in candle-power, the decrement amounting finally to more than 50 per cent., and rapid, followed by slower, falling of efficiency, to a final value of 5.75 watts per candle. These changes were accompanied by continuous and marked increase in the resistance of the filament.

If it be asked whether this individual case represents a state of affairs common to all incandescent lamps, I can only say that in my experience, which is certainly much less extensive than that of some others, I have known of no class of lamps, the performance of which did not agree approximately with that indicated by these curves. Mr. W. H. Pierce,[2] who described extended tests of the initial and average efficiency of incandescent lamps in a paper read before the Institute of Electrical Engineers some time ago, recorded no exceptions to this rule of decreasing candle-power and efficiency with time.

This falling off in candle-power exhibited by lamps maintained at constant voltage can be met by a procedure not easily applicable, perhaps, in commercial work, but readily carried out where the object in view is simply to study the behavior of the lamp under unusual conditions. The method consists in raising the electromotive force at short intervals of time by amounts sufficient to restore the candle-power to its normal value.

The results of such an experiment performed upon a lamp precisely similar to that from which the curves in Fig. 2 had been obtained, are depicted graphically in Fig. 3. Under this treatment the life of the lamp in question was not quite 100 hours. The total rise in electromotive force during the test amounted to about nine volts; the efficiency decreased from 3.118 watts per candle to 3.468 watts per candle. The resistance of the filament rose from 221.6 to 234.8 ohms. During the first 50 hours the changes were slight, then occurred a sudden increase of resistance, accompanied by marked rise in electromotive force and in amount of energy consumed.

1. John W. Howell: *Transactions* of the American Institute of Electrical Engineers, vol. v, p. 237.
2. W. H. Pierce: *Transactions* of the American Institute of Electrical Engineers, vol. vi, p. 298.

The life history of the incandescent lamp at still higher temperatures does not differ essentially from that which we have just been considering, but the changes in question go on much more rapidly.

In Figs. 4 and 5 are recorded the performances of two lamps which were similar to those from which the curves in Figs. 2 and 3 had been obtained. The first of these (see Fig. 4) was started at 57 candles. It was maintained at constant voltage for 11 hours and 30 minutes when it went out. During its brief life the candle-power fell to 24.6c. and the watts per candle increased from 1.58 to 3.09. The loss of candle-power during the experiment was 55 per cent., an amount which corresponds very closely with the loss suffered by the first lamp tested during the 800 hours that it lasted. In the case of the other lamp (see Fig. 5), the initial candle power (64 candles) was maintained throughout. Its life under these circumstances was 140 minutes, during which short period it had been found necessary to raise the electromotive force from 114.08 volts to 129.53 volts. The efficiency of the lamp fell, meantime, from an initial value of 1.33 watts to 1.677 watts at the end of the first hour; then more and more rapidly to 1.945 watts at the end of the test.

The conclusion to be reached from these data, and from the great mass of experimental results which has accumulated since the incandescent lamp has become an object of investigation, is only too evident. The efficiency of an illuminant in which carbon is the glowing material, is a function of the temperature. It appears that the incandescent lamp is fairly stable only at temperatures for which its efficiency does not exceed about five watts per candle. We have just seen what occurs when one attempts to maintain lamps at degrees of incandesence corresponding to a much higher temperature. It is, perhaps, not possible to point out with perfect definiteness, all the causes that are at work to reduce the candle-power. The black coating which gradually forms on the interior of the lamp-bulb intercepts more and more of the light from the filament as the age of the lamp increases. The growth of this film and its power of absorbing light have recently been carefully studied by two of my advanced students, Messrs. B. E. Moore and C. J. Ling.

The life curves which I have just shown you were made by them as a necessary part of their investigation of the loss of light due to the opaque film, and I will venture to take from their work, as yet unpublished, the results which they have obtained in the case of the lamp to which the curves in Fig. 2 refer. These results are given graphically in Fig. 6. They show the amount of light of each wave length of the visible spectrum which the coating on the interior of the bulb absorbed. The measurements were made after the lamp had been in operation 100 hours, 200 hours, 400 hours and 800 hours. In the diagram, abscissae are

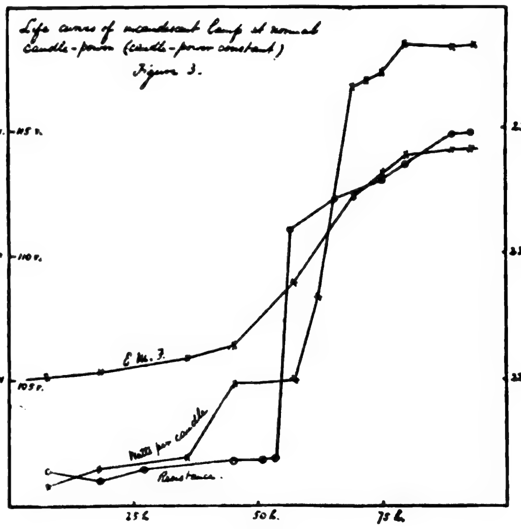


Fig. 3.

wave lengths and ordinates show the amount of light transmitted by the lamp bulb at the above mentioned times, in terms of the amount which the bulb allowed to pass before the coating began to form. You will see by a glance at these curves that the absorbing power of the film was very nearly uniform throughout the spectrum, so that the blackening of the lamp had no appreciable effect upon the light which it emitted; also that the absorption at the end of 200 hours was considerably more than half as great as that at the end of 800 hours, and that the total loss of candle-power due to blackening was about 22 per cent.

These measurements enable us to account for rather more than one-third of the loss of candle-power suffered by the lamp. We are not, with our present knowledge, in position to speak so definitely concerning the other two-thirds, but the increase in the

resistance in the carbon indicates another source of diminution. That gradual failure of the vacuum which the use of the spark-coil would unquestionably have enabled the observers to detect, may well be answerable for the rest. Now, the temperature of an incandescent lamp filament at five watts per candle is very nearly the same as that of the carbon in the light-giving flames produced by the combustion of oils and gas, and it appears that the attempt to pass this temperature introduces difficulties of such a nature as to lead to the serious question whether we have not reached a definite limit, beyond which incandescent carbon ceases to be permanent.

At that limit the efficiency of the lamp is very small indeed, 95 per cent. or more of the radiant energy emitted being of wave lengths too long to afford light.

As to the arc light, no more encouraging report can be made. On the contrary, it is perfectly well established that the quality of the light, instead of increasing, has fallen off, in the course of the development of the lamp from the clock-work regulators of Dubosc and Foucault, with their slender carbons, to the commercial lamps of to-day.

The researches of Nakano,[3] Marks[4] and others, show that the efficiency of the arc is a definite function of the current density at the terminals of the carbons, increasing nearly in inverse ratio to the cross section of the pencil. When the maximum current capacity of the latter has been reached, the efficiency is in the neighborhood of 10 per cent., a value which is not likely to be greatly exceeded by any of the methods in vogue at the present day.

As Mr. Edward Weston[5] says in his discussion of Nakano's paper on the efficiency of the arc lamp: "The small amount of luminous energy, compared to the total energy employed, is a sad thing always."

In the vast accumulation of experience which the past years have witnessed, nothing has come to general knowledge which looks to the raising of the barrier which blocks our progress. It seems only too probable that the limiting temperature at which carbon can be used for the production of light has been reached, and with it the maximum efficiency of artificial illumination.

The phenomena observed whenever we attempt to raise carbon above what may be termed its normal temperature of incandescence are significant, and they all point in one direction. We have just seen that when we raise the voltage of an incandescent lamp, we gain splendor of performance at the cost of permanence and stability. I might remind you, in this connection, that when the heat of gas flames is increased by forced draft, they become non-luminous; that the magnificent illuminating power of the arc lamp is not due to the intensely hot electric arc itself, filled, though it be, with carbon in process of transfer from the positive to the negative pencil, but to the cooler carbon terminals. Such are the facts with which we have to deal when we consider the problem of increasing the efficiency of illumination

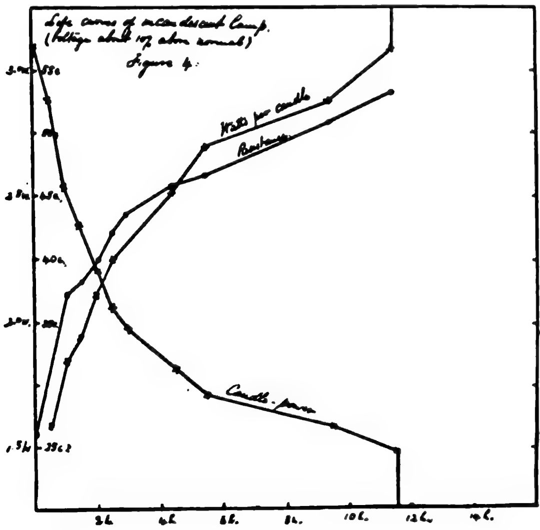


FIG. 4.

by carbon, whether by direct combustion, by incandescence in vacuo or by the use of the electric arc. In the face of the many unexpected things that have been accomplished through the agency of electricity, he would be rash who asserted that the possibilities of carbon had been exhausted. In view of the achievements of the time one is not permitted to declare the case hopeless; nevertheless, the outlook is not an encouraging one.

If, in what I have said thus far, I have drawn what seems to be a gloomy picture, it is not because I fail to recognize the importance of the electric light of to-day as a factor in our civilization. Its superiority over other methods of artificial illumination is so well understood that it need not be enlarged upon here. Of its advantages we hear on every hand; of its limitations we hear less; and yet a knowledge of the latter is quite as important to those who are interested in its further development. The waste of 90 or 95 per cent. of non-luminous energy in the production of light is a matter to which we are apt to give little thought, and when the economic importance of the fact has been forced upon us by the study of the recent investigations which have been made to establish it, we find consolation in the thought that, after all,

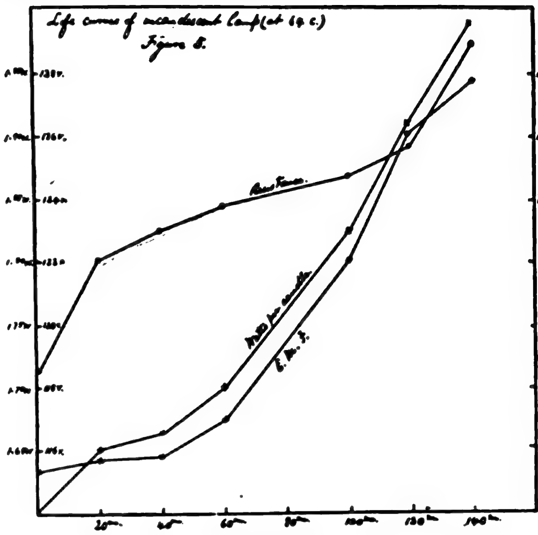


FIG. 5.

those percentages are somewhat larger than the corresponding values for candles, oil and gas.

As time goes on, however, the question of the efficiency of illuminants will increase in practical importance. No one of us, I take it, is of the opinion that the world will always be content with the present extravagant methods of obtaining light. Progress in these matters is chiefly a question of the careful and exhaustive study of the properties of the substances with which the inventor and engineer have to deal. As in the past, so to-day and in the future, researches in the laboratory must prepare the way for operations in the workshop and manufactory. I have thought it not without interest, therefore, to discuss the behavior of incandescent carbon under conditions, some of which are not "commercial," and to attempt to point out the significance of that behavior. Now, if you will permit me, I will turn toward the future and consider the properties of some other sources of light, with the view of inquiring whether they may not have a part to play in the artificial lighting of days to come.

What is to be the light of the future? From the standpoint of the engineer I will frankly say that I cannot answer that question, but abandoning the directly practical point of view, there is something to be said. I need offer no apology here for presenting facts, the application of which is at best remote, and the present importance of which is therefore rather scientific than utilitarian; nor need I remind you that all the so-called "forces of nature" which have been yoked and impressed into the service of man were the object of scientific curiosity and the subject of scientific investigation long before the idea of a practical application was entertained.

The number of elements and of compounds capable of sustaining a high temperature without dissociation or change of state is very large. Carbon is the only one of these, the capabilities of which as a source of light, can be said to have been fully tested; and yet all the others, when heated to a proper point, emit light-giving radiation. Take for example the metallic oxides. We heat the oxide of calcium in our magic lanterns and it gives us a light of great intensity and but little inferior to the arc light in whiteness. The exceeding clumsiness of our method of rendering it incandescent, however, has prevented its adoption excepting for certain special purposes. We burn magnesium in fire-works and for photographic flash lights, and occasionally we indulge in the luxury of igniting a bit of the ribbon and admiring, for an instant, the intense brilliancy of its flame. Now, magnesium is one of the most abundant elements on the face of our planet. It is a rather costly metal at present, being quoted at 50 cents an ounce in this country and at about half that price on the continent of Europe. Even under the limited demand for it which exists at present, it has fallen to about one-tenth of its price of a few years

3. Hatsune Nakano: *Transactions* Am. Institute of E. Engineers, vol. vi. p. 308.
4. Louis B. Marks: *Transactions* Am. Institute of E. Engineers, vol. vii. p. 175.
5. Edward Weston: *Transactions* Am. Institute of E. Engineers, vol. vi. p. 20.

ago, and I feel sure that it lies within the power of the electrician to greatly further reduce the cost of production. Among artificial illuminants, magnesium has in one respect no equal. W. H. Pickering, who studied its spectrum in 1880, found it to approach sunlight in quality even more closely than the electric arc light does.[6]

The precise character of the magnesium light is shown in Fig. 7. The abscissæ of the curves are wave lengths, and ordinates indicate the brightness of each portion of the spectrum of the magnesium flame in terms of that of the corresponding regions in the spectrum of gas light. The accompanying curves for the arc light and the lime light, introduced for convenience of comparison, are from measurements by Mr. W. S. Franklin and myself. These curves all refer to lights of the same candle-power. It will be seen that the magnesium flame is about 10 times brighter in the violet than a gas flame of the same power, and but little more

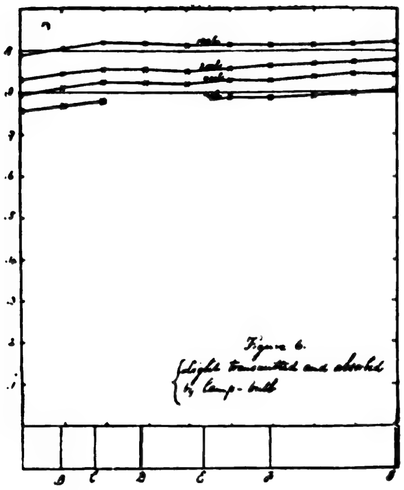


FIG. 6.

than half as strong in the red. It will be seen, also, that it surpasses the electric arc everywhere beyond the yellow, save in a very limited region of the extreme violet. In order to appreciate fully the significance of these curves, one must have had occasion to compare the various lights to which they refer, placing them side by side and noting the effects. You are all aware that the magnesium light is very white and very powerful, but unless you have happened to see it in direct competition with our ordinary illuminants, you will be but dimly conscious of the difference between them.

I have here a simple magnesium lamp of European manufacture. By means of a simple arrangement of clockwork, it feeds a thin magnesium ribbon at a rate just sufficient to maintain a flame of between 40 and 50 candle-power. Turn your attention for a moment to the screen just behind us. It gives you the impression of a nearly uniform white surface, which is well lighted by the incandescent lamps with which this hall is so abundantly supplied. Its whiteness now, however, is a very different thing from that which it will take on under the rays of the magnesium light. I light the little clockwork lamp, placing it so that it illuminates a portion of the screen. That part which is shaded from the lamp is just as well lighted as it was before, and its tint is in no way changed; but no one would be likely to describe it as a white surface under the present circumstances. It has sunken by comparison into a rather weak chocolate brown. Let us turn the lamp so that you can see the burning magnesium, and place beside it, to emphasize the contrast, this lighthed candle. How dull and sickly the candle flame appears, and yet, though old-fashioned and rather out of date among our modern glow lamps, the candle does not suffer greatly, so far as quality of light goes, by comparison with them.

I have been much interested in studying this source of light, and I will venture to give you some of the results which I have obtained. This lamp consumes 168 milligrammes of magnesium per minute. It is difficult to determine its candle-power by ordinary methods, because of the enormous difference between the color of its light and that of gas light. By means of measurements made with the horizontal slit photometer, an instrument the use of which entirely obviates this difficulty, I found the light to average slightly more than 40 candle-power. Assuming 40 candles to be the correct value, we have 4.2 milligrammes of magnesium consumed per minute per candle. Now to maintain one candle-power of gas light one minute with an average quality of illuminating gas, 137 milligrammes of gas must be consumed. With gas at $1.00 per 1,000 cubic feet and magnesium at $10.00 per kilogramme, a price which is in excess of the present European rate, the magnesium light would cost, candle for candle, about 6.72 times as much as gas. With magnesium at $1.49 per kilogramme, or about 67 cents a pound, the cost of the two illuminants would be the same. Looking at the matter from a slightly different point of view, we may say that since 4.2 milligrammes of magnesium will give as much light as 137 milligrammes of gas, their relative productiveness as illuminants is as 33.1 to 1. The true relation between their value is, however, expressed by a larger ratio than that since, candle-power for candle-power, the real worth of a source of light increases with its temperature. The total luminosity of the arc light, for instance, may be considered fully 25 per cent. greater than that of gas. Two candle-power of sun light is the equivalent of three candles of gas light. The luminosity of the magnesium light lies between these two values.

The proper way to compare sources of illumination is to determine their net and gross efficiencies; by which I mean, respectively, the ratio of total radiation to light-giving radiation, and the ratio of the total amount of heat set free in the process of producing a candle-power of light, to the heat energy represented by the light itself. Now the heat equivalent of a candle-power of gas or of the light of an incandescent lamp at five watts per candle, is about 3.6 gramme-calories per minute. The total heat of combustion set free in generating a candle-power of gas light has been variously estimated at amounts ranging from 971 gramme-calories per minute (Preece) to 4,100 gramme-calories (Thomsen). Calculations based upon the theoretical heats of combination of illuminating gases, give values nearer the latter than the former amount.

The amount of heat set free when a gramme of magnesium is converted into the oxide is very much less than that resulting from the combustion of a gramme of coal gas, and the light obtained is, as we have just seen, more than 32 times as great. The gross efficiency of the magnesium light must, therefore, be many times higher than that of gas light. To be exact, we find, if we adopt the value given by Thomsen[7] for the heat of combination of magnesium (6077), that the magnesium flame of one candle-power should generate only 25.52 gramme-calories per minute. Taking the very low estimate of 1,000 gramme-calories per minute for gas, *we find the gross efficiency of the magnesium flame to be about 40 times that of gas light.*

The simplest method of determining the net efficiency of a source of light is that recently applied by Mr. Merritt to the study of the incandescent lamp.[8] I have measured the efficiency of the magnesium flame by Merritt's method, which consists in receiving the radiation upon the face of a thermopile. A glass cell containing a solution of alum is placed between the flame and the pile. This cuts off almost all those rays which do not produce

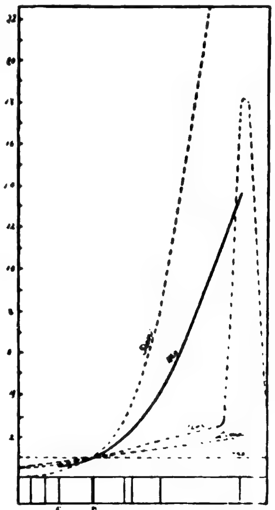


FIG. 7.

light and permits about 75 per cent. of the luminous waves to pass. After observing on a suitable galvanometer the deflection produced by the light giving radiation, the cell is removed and the deflection noted again. The ratio of these two readings, properly corrected, gives the net efficiency of the source of light. In the case of the magnesium flame, at least 15 per cent. of the total radiation was found to belong to the visible spectrum. Let us consider the matter from another point of view. When we disperse the rays from any source of light by passing them through a prism or reflecting them from a diffraction grating, we find that we have to do with a great many rays which are of a wave

6. W. H. Pickering: *Proceedings* of the American Academy of Arts and Sciences, vol. xv., p. 240.

7. J. Thomsen: *Journal für Praktische Chemie*, N. F., 16, p. 97.
8. Ernest Merritt: *American Journal of Science*, vol. xxxvii, p. 167.

length too great to affect the eye. These constitute what is called the heat spectrum, and they are accompanied by a few rays which are of the wave lengths capable of optical action. By means of the thermopile or the bolometer, it is possible to explore the whole spectrum, and to determine the intensity of the radiation of each wave length which the source emits. From these values the curve of distribution of heat in the spectrum may be plotted. The curve consists of two parts: That which gives the energy of the light-giving rays, and that which shows the amount of radiation outside of the visible spectrum. The ratio of the areas enclosed by these two portions of the curve is the net efficiency of the source of light. Such curves for the flames of candles, oil and gas show that less than two per cent. of the total radiation is luminous. In the case of the incandescent lamp the amount rarely exceeds five per cent. The arc lamp contains about ten per cent. of useful rays. The magnesium light, therefore, according to the data which I have just presented, possesses a much higher net efficiency than any of the other sources of artificial illumination. To what does it owe its superiority?

We have seen that, weight for weight, magnesium affords more than 30 times the light obtained from gas, with the development of much less heat. The quality of the light is such that merely from the standpoint of illuminating power, to say nothing of the additional æsthetic value of a light which approaches sunlight in whiteness, each unit of it must be regarded as the equivalent of rather more than 1.25 units of light.

The character of the light corresponds to a temperature much above that of the electric arc, but the flame does not seem to be very hot. I have not as yet succeeded in obtaining a satisfactory measurement of the flame temperature, but a preliminary test, made at my request, gave approximately 1,400°C. This value, which is presented subject to correction, enables us to classify the magnesium flame, at least placing it among those the temperature of which is far below the melting point of platinum. Its temperature, probably, does not differ widely from that of the luminous gas flame.[9]

The large candle-power of the magnesium flame is due to its peculiar structure. A gas flame consists of a column of heated gases, the particles of which are rising rapidly from the jet of the burner. These carry off with them, by convection, 80 per cent. or more, of the heat of combustion. The flame owes its luminosity entirely to the fact that near the base of the column a few particles of carbon, as yet unoxidized, are heated to incandescence. The total radiating surface of these particles is very insignificant, compared with the apparent superficial area of the flame; it is, indeed, not very different in extent from the radiating surface of the filament of an ordinary incandescent lamp of the same candle-power. The constitution of the magnesium flame is very different. The product of combustion is the oxide of magnesium, a white, amorphous solid of considerable density; it is, indeed, fully twice as heavy as the metal itself. The oxide remains, for the most part, in the place where it was first formed.

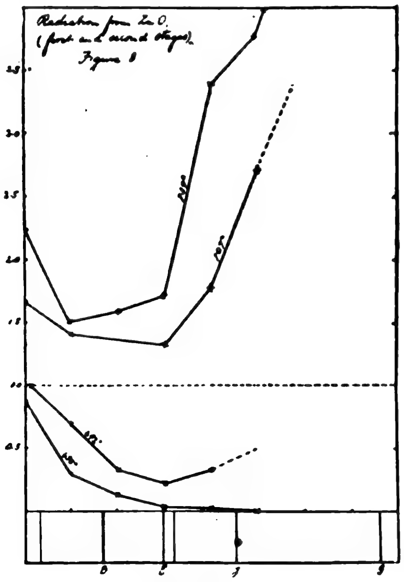


FIG. 8.

It becomes intensely incandescent, and having large radiating surface, it affords a large amount of light. Under such conditions, convection plays a minor part, and that which is the chief source of loss in the production of light by direct combustion of gaseous fuels is avoided. The gross efficiency is, therefore, very large.

The question of the *character* of the radiation from the magnesium flame offers greater difficulties. It is certain that neither platinum nor carbon at any temperature to which they can be subjected in practice, will give anything approximating to the quality of the magnesium light. I am convinced that we have to do here wilh a very different law of radiation from that which governs ordinary cases of incandescence. Taking carbon to represent the normal state of affairs, we may say that the radiation of magnesium oxides is out of all proportion to the temperature of incandescence; also that the precentage of those shorter wave lengths, which furnish green, blue and violet light, is abnormally large. That the radiation of the magnesium flame

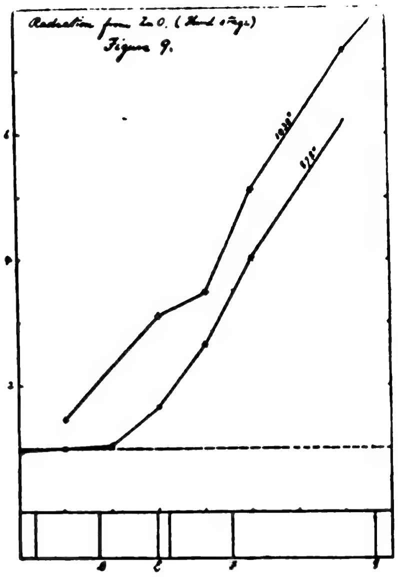


FIG. 9.

comes in part under the head of what Prof. E. Wiedemann has termed "Luminescence," I have little doubt. This word covers all these interesting phenomena known as phosphorescence, fluorescence, etc.

Luminescence is supposed to be due to a different class of molecular vibrations from those which cause ordinary incandescence. One of the characteristics of this class of vibrations is that it tends to produce selective radiation; that is to say, radiation in which a single wave length, or set of wave lengths, predominates. Another characteristic of luminescence is, that it is frequently, perhaps always, the result of previous treatment to which the glowing body has been subjected. This previous process may have been nothing more than the shining of the sun's rays upon the luminescent surface, as in those cases of phosphorescence concerning which Becquerel has taught us so much.[10] It may have been in the course of some chemical reaction or process of crystallization that the body received its preparation. In such cases the power lies latent until it is disengaged by the action of some external force.

The immediate exciting cause may be mechanical, electrical or thermal. In the last case, which most directly concerns us here, a certain rise of temperature is necessary to start the body into luminescence. When this critical temperature is below the red heat the phosphorescent glow attracts attention, and investigation follows. When, however, the temperature of luminescence is high, the effect, however marked it may be, is masked by the ordinary incandescence to be expected at that temperature, and it is overlooked. Luminescence by heat is perforce transient. It is due to the expenditure of energy which has been stored by previous action. If we wish to see the effect repeated we must restore to the material the potential energy which it has lost.

I am not in position to state positively that the glow of magnesium oxide is due to luminescent vibrations, but I am of the opinion that such will be found to be the case. Other metallic oxides also show peculiarities of radiation which find their explanation most readily under that theory. While studying the distribution of energy in the visible spectrum of the lime-light, three years ago, Mr. Franklin and I found that a freshly ignited cylinder, under the oxy-hydrogen flame, glowed with a brilliancy equal to that of the magnesium light itself.[11] This state of affairs lasted but a moment, however, and no amount of heating would bring out an old cylinder again into its initial splendor. It was plain that we were taking advantage of vibratory power stored in the lime at some stage in its preparation. These vibrations, dis-

9. Rossetti (*Beiblætter zu den Annalen der Physik*, 2 p. 333) gives us the temperature of the gas flame, 1840°: of the positive carbon of the arc, at the hottest point, 3,900°: of the negative carbon, 2,450°.

10. Becquerel; *Annales de Chimie et de Physique* (3), 55; p.

11. See the *American Journal of Science*; vol. xxxviii, p. 100.

engaged by the blowpipe, gave out in a very short time, after which the performance of the lime degenerated rapidly to the level which corresponds to ordinary radiation at the temperature in question.

You are all acquainted with the beautiful greenish-yellow light which the oxide of zinc emits under the flame of the blowpipe. It is entirely different from the light of the incandescent charcoal on which it lies, although the two cannot differ widely in temperature. The zinc oxide is luminescent, the carbon is simply incandescent, in the usual sense of the word. This is a case which lends itself readily to study, since the temperature at which the abnormal glow appears, is a comparatively moderate one. Last summer I took the matter up, with the efficient coöperation of Mr. B. W. Snow, Instructor in Physics in Cornell University. We made a systematic comparison of the radiation from zinc oxide and from platinum, at temperatures between the red heat and 1000°C., measuring temperatures and studying spectra by methods which I cannot dwell upon here. Since the results which we obtained are of a character to illustrate the points which seem to me most significant, in this question of the radiation of the metallic oxides, I will indicate them graphically.

Zinc oxide is a rather brilliant white pigment. Its radiating power, therefore, according to the theory of exchanges, should be very small. At temperatures below 700°C. we found it to be very much lower than that from platinum throughout the spectrum, and the light from the oxide to be of a duller red. Fig. 8 shows the results of the comparison. In this and the subsequent curves, platinum is taken as the standard. The curves show how the oxide of zinc compares with platinum in strength of radiation. The law according to which the visible radiation of platinum rises from zero at the extreme red heat, as the temperature rises, varies with the wave length. It had to be especially determined for the purposes of our investigation in each region of the spectrum to which our measurements were extended.

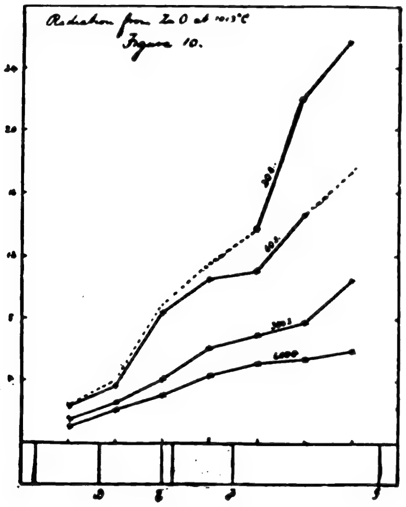


FIG. 10.

At about 700° a sudden change occurs in the character of the light from the oxide. It becomes brighter than the platinum of the same temperature, the increase showing itself principally at the ends of the spectrum. In Fig. 8 (707° and 739°) we have curves which represent this second phase. The emanations are selective to a marked degree, the yellow being relatively very weak. Measurements of fresh films of the oxide at still higher temperatures revealed the further development of the abnormal radiation of this substance. Fig. 9, which gives curves for 878° and 1,084°, shows the transition into a third, and, apparently, a final stage. The red end of the spectrum loses its prominence, and the curve seems to be developing into a straight line, the trend of which is such as to indicate that zinc oxide, as we pass from the longer to the shorter wave lengths of its spectrum, increases in superiority over platinum at the same temperature.

It soon became evident, from the character of our results, that the radiation at temperatures above about 800° were of a very evanescent sort, falling off in intensity and changing in quality from the first instant in which the oxide was heated. To follow these rapid changes proved a trying task. By taking a great many fresh films of the oxide and watching the time changes of one portion of the spectrum after another, however, we were able to obtain data from which the curves in Fig. 10 were drawn. These show the intensity of radiation and its character, relative again to that of platinum, after the oxide had been maintained 1,013° for a period of 30 seconds, of 60 seconds, of 300 seconds, and of 600 seconds. At the end of the 10 minutes the changes, although not entirely completed, were very slow.

The evidence of the existence of luminescence afforded by these measurements seems to us to be nearly conclusive. Extension of the investigation to other of the metallic oxides, and to wider ranges of temperature, would, doubtless, lead to results more striking.

The application of all this to the problem of the light of the future is as follows. The fundamental question is that of efficiency. High efficiency at low temperature means selected radiation, which appears to be a characteristic of luminescence and not of ordinary incandescence. The study of the radiation of the metallic oxides above the red heat reveals the existence of properties which lead us to regard them as being luminescent "by heat." It is from such bodies that radiation of high efficiency is to be looked for. We have in magnesium oxide a member of this particular class, and we have seen that when it is heated in the process of formation it gives us a light the efficiency of which is unapproached by that of other artificial illuminants.

The problem is easily stated. (1) We need a body which is rendered vividly luminescent by heat.—The metallic oxides would seem to offer us many such. (2) The material is to be brought to the temperature at which its luminescence is most marked.—Does it not seem probable that the best method, as in the case of carbon, will not be that of direct combustion, but of heating through the agency of the electric current? (3) The material must be restored from time to time.—Whether rejuvenation is to be secured through electrical, chemical, actinic or mechanical means remains to be determined.

Luminescence "by heat" offers, however, only a partial solution of the problem of the highest efficiency. However great the efficiency of the luminescent itself, it is accompanied by incandescence of the ordinary kind. The ultimate solution is to be sought for along other lines. Incandescence is too expensive a means of exciting luminescence. There are many other ways in which it may be generated; friction, chemical action, the impact of light waves, electrical excitation, certain vital processes, are known to result in the production of light. The physics of these phenomena is, for the most part, undeveloped. I know of but two attempts to determine the efficiency of this "light without heat," as it has sometimes been called. The intensity is, as a rule, very small, and the heat has doubtless been regarded as quite below the range of even our most sensitive apparatus. One of these two cases is of especial interest to the electrician. It is that of the spark discharge in vacuo. Prof. S. P. Langley and Mr. F. W. Very, in a recent remarkable paper, entitled, "The Cheapest Form of Light," speak of the heat generated in the Geissler tube as so minute as to seem to defy direct investigation. It has, however, been successfully measured by Dr. Staub, of the University of Zurich, by means of one of the most delicate instruments for the measurement of heat—the Bunsen ice calorimeter.[12]

In Staub's experiments the vacuum tube was smoked with lampblack and inserted in the ice calorimeter. The ice melted in a given time afforded a measure of the total heat generated by the electric discharge through the tube. A repetition of the determination with the unsmoked tube, under which conditions the light-giving rays could escape, gave the energy of the non-luminous radiation. The efficiency was found to be 3.268 per cent. The extremely small candle-power of the light derived from the electric discharge in vacuo, may seem to preclude all questions of its utilization in practical illumination. The result is one, however, which should not be lost sight of. It suggests a field of investigation which may prove unexpectedly fruitful.

The Geissler tube effect was not the source to which Langley and Very applied the term "the cheapest form of light." The subject of their research was the light of a Cuban fire-fly. Their work cannot fail to excite the highest admiration of every one who is able to appreciate the difficulties of such an investigation. The exploration of the heat spectrum of so insignificant a source of light is a task which very few physicists, would, I think, have considered practicable, but it has been carried through by these investigators to complete success.

When we study the curve of distribution of energy in the spectrum of the fire-fly thus obtained, and compare it with the corresponding curves for gas light, the arc light and sun light, we find the expression, "the cheapest form of light," which is applied to the light of the fire-fly by Langley and Very, to be fully justified. All the energy of its spectrum is massed within the narrow limits of the visible spectrum, and what is more, by far the greatest part of it is in the form of rays which are especially important for the purposes of radiation, the particular rays which give us yellow and green light. The non-luminous radiation which accompanies the light of the fire-fly seems to be so insignificant that it was with difficulty that it could be estimated, even with the almost inconceivably delicate apparatus used by Langley and Very. They give the efficiency as about 400 times as great as that of a gas flame. It cannot fall appreciably below 100 per cent.

In what I have said this evening, I fear that I have fallen far short of what might have been expected of a lecturer on the artificial light of the future. I have endeavored to show that the

12. G. Staub: Inaugural Dissertation, Zurich, 1890. (See the *Beiblaetter zu den Annalen der Physik*, 14; p. 538.)

efficiency of our present methods is too low to meet the demands of the future for economical illumination, and that whether we ever succeed in approaching the perfect economy of nature's light-making processes, as exemplified in the fire-fly, or not, there are many sources of light which promise high efficiency. If I have succeeded in indicating, even vaguely, some of the conditions of the problem of the utilization of these, and in pointing out some of the lines of investigation which are to be followed in the development of new methods of lighting, my mission has been fulfilled.

CORNELL UNIVERSITY, Nov., 1890.

COLUMBUS MEETING OF THE OHIO STATE TRAMWAY ASSOCIATION.

THE ninth annual meeting of the Ohio State Tramway Association was held in Columbus on Nov. 19, and was called to order by Hon. J. N. Stewart, vice president, of Ashtabula, O. A large number of delegates and trade representatives were present.

Afternoon session called to order by President Stewart at 2:30 o'clock.

MR. C. K. HARDING, president of the Harding Electric Railway Co., of Atlantic, Ia., described his system as follows:—"It was to avoid some of the overhead and other difficulties that I devised the conduit system to which I desire to call your attention. Heretofore the word "conduit" has been almost inseparably connected with some slotted arrangement, and failure and failure, for it should be understood to preserve insulation you must exclude water, and to do that the conduit must be entirely closed, without slot or other opening through which the current is taken. In order to accomplish this result I employ a tubular iron casing, in the top of which is a channel or flanged portion in which is insulated and supported the section of working conductor. These sections may be from four to six feet long and extend an eighth of an inch or more above the surface and are normally insulated from each other; the casing and the main conductor which extends through the lower tubular part is entirely surrounded and embedded in insulating material. In the end of each section of the casing or conduit, there is an enlargement of the lower tube which forms a junction box in which is located a small electro-magnetic contact making device, which when operated connects its conductor section with the main or supply conductor. One end of the winding on the magnets of these contact devices is connected through a simple switch to the adjacent working conductor section, and the other end directly to the conductor section on the other side by means of this arrangement and a second brush on the car. I employ a very small portion of the current to automatically operate the contact device and bring the exposed sections of working conductor separately and successively into connection with the main insulated supply conductor when these sections are immediately under the car and protected by it.

In other words, I get the current to the car through the series of insulated exposed sections which are fed from the main conductor as the car passes along and are at all other times completely insulated from the wire carrying the current. By the employment of a derived circuit in multiple arc with the motor circuit I am enabled to use a very small portion of the main current for the operation of the contact devices, and to make the magnets of small size and wind them with iron wire, thus making the construction of the contact making devices a comparatively simple matter and enabling them to be placed in a small closed cavity in the end of the sections where they will be readily accessible and are adapted to be interchangeable.

It will be readily seen that the short exposed sections of working conductor will have very high insulation and prevent all but the most inappreciable amount of leakage when it is taken into consideration that under no possible combination of circumstances can any sections except those immediately under the car be brought into or maintained in connection with the supplying current. The placing of the wire underground will remove the possibility of any trouble from lightning; and the position of the wire and the fact that the return current passes through the track rails and the conduit casing near to and parallel with the supply current precludes the possibility of inductive interference with telephones.

MR. CURTISS, of the Short Electric Railway Co., said:—"I do not know that I can say anything to the convention regarding the Short system with which you are not already perfectly familiar. The largest contract ever let in this country by disinterested parties was given by a syndicate of Philadelphia gentlemen for equipping the street railway system of Rochester, New York, to our company. That, as you probably know as well as I, was given after a very thorough and careful investigation by experts who came to our factory, went through the works, visited our system working in different places and made their report. On the basis of that report the purchase was made for Rochester.

Now, that which has heretofore been, I believe, the curse of electrical railroading in its practical operation, was the one item of repair. I see gentlemen here who know very well how much this has amounted to. In one town, I am told by gentlemen connected with the road that the repairs last year amounted to as high as $1,100 per car. When I went into the Short Company they had a road running in Muskegon, Mich., equipped with our system. That road had been running for six months, commencing with five cars and at the end of the six months having nine cars in operation, and the total repairs on that road have not exceeded $100 on all the electrical equipment. You can appreciate the advancements which we have made. We believe we have got now to very near the perfect theoretical point, and we invite cordially your investigation in that direction.

There is one point that I have had called to my attention since I arrived, only proving that a man must go away from home to get information regarding one's own business. I heard remarks in the convention on consolidations. If there has been any consolidation of the Short Electric Railway or any other railway, it has occurred since I left home this morning at seven o'clock. I do not of course know where the rumors may have started, but there is no foundation for them in fact.

MR. C. A. BENTON, of Detroit, Michigan, as representing the Rae system, then said:—I represent the only "single motor" system that I believe is in successful operation. The peculiar feature of our motor over that of other systems is, that it is geared to both axles, a construction which permits the use of large wearing parts, slow speed of armature shaft, and therefore reduced friction and long life. It secures perfect insulation between the motor and the truck, eliminating all electrical strain and making burn-outs from this cause impossible. By the way, reference has been made to the economy of electrical street railroading, and as to the extent of repairs required. A statement has been made in your presence by Mr. Curtiss which was intended to impress you with the belief that his system reduced the expense of repairs to the minimum. To borrow a slang expression, "I will go him one better." Mr. Curtiss says that six cars running for six months at Muskegon, Michigan, required repairs to the extent of $100. We have twenty-one cars running at Saginaw, Michigan, which have been run for eleven months and the repairs on the entire equipment have not reached the sum of $50. A man who went there to do the winding in case of a break had nothing to do, and they finally bought him a uniform and have been using him as an extra conductor on the line. This is absolutely true, and if you don't believe it you can go there and see him. Some people think we are a little bit new in this business, but we are not. Several years ago, in fact six years ago, about 1883 I think, Mr. Rae first built an electric motor, and during the time which has elapsed between that time and this he has been busily engaged in perfecting it. We have during the last two months closed certainly some important, even if they were in the minds of some, small contracts. Mr. Curtiss, how many cars were in your Rochester contract?

MR. CURTISS—1,000.

MR. BENTON—Well, ours is not over a quarter of that. (Laughter.) However, we think we can run four times as well and four times as long as the other system, so we will even it up. (Renewed laughter.) The Detroit Electrical Works are in this position. They are sound financially, their guarantees are good, they are prepared to send a truck motor to any responsible street car line having any system and put a car upon it and leave it for them to use. Now, gentlemen, if you care to, I can show you a model that I have in my room at the Neil House, or, what is better still, we will have one running here tomorrow on the Glenwood and Green Lawn road. It would have been here to-day but for the same kind of a mishap as that which occurred to Mr. Brickwood with his carette; the steam railroad failed to keep its promise in getting it delivered here by the time agreed upon.

MR. CLEGG—What is the weight of your motor as compared with others?

MR. BENTON—It varies very little from the Sprague, or the Short. I think it is a little lighter than the Thomson-Houston.

MR. CLEGG—It struck me that it was much lighter.

MR. BENTON—There is but very little difference. The weight, of course, would vary some from this reason, that we weigh them on the trucks and sometimes we have heavy wheels on the truck and sometimes not so heavy, and for this reason the weight varies a little.

MR. F. B. BROWNELL, of the Brownell Car Company, St. Louis. Missouri, then spoke as follows:—The leading subject now among street railroad people, I think, is the subject of electricity as a motive power; but it has always appeared to me that the proper amount of thought has not been given to the mechanical construction and operation of the car. Electricity itself is a matter that I know very little about, in fact almost nothing, but the transmitting of the electric current to the car axles through mechanical appliances, is in my judgment far from being perfect. We have a very large electric road in St. Louis now that has been in operation only a very short time. In conversation with the superintendent a few days ago he told me that the defects in the electric trucks were very many, and that it seemed to him (and to me also) that the people jumped at the construction of the electric truck without giving the matter proper consideration.

In most of the electric trucks that I know of, the motors are located very close to the ground. The movement is very rapid, and the tendency to draw in foreign substances from the street is very great, and I do not believe that we are going to get an economical car until some change is made in the location of your motor. The thought has occurred to me that the present electric car in general use is only the ordinary street car, but made more elaborate and finer and larger and better finished inside, but the motors are located on the trucks underneath this car. Now if there is anything the matter with your car to prevent its running, it will be most likely in the trucks.

The result is that you have to run this expensive car into your car shed, and throw up the trap doors, and the mechanics get in there with their soiled clothes and greasy hands, and throw tools and traps up on the cushions in their effort to repair the track, and the car is very apt to be injured and costs not a little money to put it back. It would seem to me that the better mode would be the use of cars in trains, a motor car with a passenger coach as elaborate as you see fit to use and the more elaborate the better it would be for the car builder (laughter); the motor car to be made small and strong and plain so that the liability to injury by the handling of tools and parts of the mechanism of the car would not be much, and then to have that motor car used entirely for that purpose.

I have thought also that the motors instead of being horizontal and close to the ground, should be located vertically and so arranged that every part could be easily got at for repairs or removals or renewals, or whatever might be necessary to do with them and the whole system of construction changed to something that is practical and desirable, which the present mode I do not think is.

Then again there is another subject, which I think should be considered, in connection with the operation of these electric and cable roads, and that is the fearful liability to accident. You can scarcely pick up a daily paper but what you will find an account of some one killed on an electric or cable road in some part of the country. I find that nearly all the electric cars, and nearly all the cable cars, excepting of course those built by ourselves (laughter), have got a fender or so-called life-preserver constructed somewhat after the principle of a locomotive pilot. Apparently the parties who first built an electric or cable car, saw the necessity of something, and without stopping to think, they concluded that the locomotive pilot was just what they needed. Now, the locomotive pilot is not designed to preserve the life of anything that may be on the track. The engineer of a locomotive, if he sees a man or an animal on the track, will try to stop his locomotive; if he sees that he cannot do it, then he will open the throttle and give the engine all the steam she will take and he will knock that object sky high and get it out of the road, and thus prevent the derailment of his locomotive and the possible wrecking of his train and great loss of life. Nearly all the switch engines around the yard, where the movement is slow and the liability to obstruction is great, are provided with a sort of platform on which a man could jump and be carried along with the locomotive until it can be stopped thus preserving life as well as preventing the derailment of the engine. This is a subject I think it is well for the railroad people to consider; the subject of fenders. There are cases on record where lives have been saved by this style of a fender, and there are many cases where lives have been lost on account of having other styles of fenders.

These two subjects I think are worthy of some thought, and I think if the railroad companies and the motor people will work in harmony on that line, and especially so far as the location of the motors are concerned, they will find that many of the troubles of the street car companies and the electric companies will be removed, and that a large portion of the money that is now used to pay the cost of repairs, can be utilized as dividends, which I am sure will suit you all very much better (applause).

MR. JOHNSON, representing the Northern Car Company, of Minneapolis, stated that the Northern Car Company was comparatively a new company and comparatively unknown to the general street railroad men of the country. The company is only about four months old. They have at Minneapolis, the largest street car factory in the United States, if not in the world. Pullman has about 32,000 feet of working surface, and the Northern Car Company has about 75,000 feet of working floor surface. They have a system of electric lights by which they can work at night when it is necessary; and in fact every contrivance in the way of machinery, tools, buildings, dry-houses, etc., by which they can make practically perfect cars.

MR. FERDENING, president of the Dayton Street Railroad Co., said: We are operating a street car line in Dayton, which we think is doing very well. We still stick to the mule and the horse. We have had under consideration and have investigated somewhat, the different modes of motive power, and had thought very seriously at one time of adopting electricity as a motive power. Yet we were not fully convinced that electricity had yet arrived at that stage when we felt justified in adopting it, and preferred to let others do a little more experimenting. I have been told by a gentleman, who had a great deal of experience in electricity as a motive power, that they are very well satisfied with it, and I have no doubt but that it is the coming motor for street car service.

MR. W. J. COOKE, vice-president of the McGuire Manufacturing Company, said: I have been very much interested in what I have heard this afternoon. I am here to learn. I commenced building trucks several years ago when cables first came in. When electricity was first introduced we had a truck which we thought was peculiarly adapted for electricity. I found out from the electric people that they had designed that the standard should be thirty horse-power. I figured from thirty horse-power up to a truck, following the suggestions of the electrical people largely. When I had completed my truck, my electrical friends said I was wild, simply crazy; that I had 1,500 pounds more than I should have. I insisted that my figures were right. The result was I did not sell any trucks for six months; they thought I had too much strain. In the last year, however, I could not make trucks enough; I am making them heavier than ever and I do not think that they are heavy enough. They have been figuring the standard on the other side from the basis of a two-horse team and came down, while I started from 30 horse-power and went up. We are not quite reconciled yet.

I am glad to hear what my friend, Mr. Brownell, has to say in regard to it. It coincides with my opinion exactly. I believe that the present mode of connecting the motor to the truck is not right. You are now getting the motor down in the mud and the dust and the dirt, and this of course creates friction in the gearing and that cuts and consequently requires repair. I do not know how the remedy is to be accomplished, but I have an idea that we will have to get up on top with our motive power. We are at the mercy of the electrical and street railway people. We want to build whatever they want. We have gotten out what we believe is pretty near the requirements of to-day, but we are ready to adopt any new device or to make any modification that the demands of the street railway people may require. We have very recently, at a very great expense, gotten up a frame made of pressed steel, the entire frame consisting of only four pieces. Noise has been a disagreeable feature to some extent in the electric motor; some motors are very noisy and some trucks are very noisy. We have gone to work and made a truck of very few pieces, less than half the number I believe used in any other truck constructed to-day. We had it on exhibition at Buffalo; a pair of trucks under a double truck car. We believe that that solved the question to a great extent of the expense as to wear and tear of truck and motor. Until very recently we have not had the matter taken up. We have now under contract 200 pair of these trucks for three different lines in Pittsburgh—double trucks; also for Sioux City; Salt Lake City; Los Angeles; Oakland, Cal., and several other places, where they have recently adopted the double truck car, 24 to 30 feet in length. We are of the opinion that that is the coming car for street car service. One long car instead of a trailer. It makes less expense on the cars, the friction will be practically nothing and it makes a saving of flange wear on the tire. The wheel base is 4 feet, 6 inches on the long car; just enough to let the motor in. The electrical people wanted us to make it longer, but we are trying to get the wheel base as near the gauge of the car as possible and we have adopted a standard of 4 foot 6, and arrange it so that we can get all of the present motors in that wheel base. Mr. Rice, of Pittsburgh, who has used these short wheel based trucks for a good many years under his cable cars, is of the opinion that it is the most economical style of truck to use, both as to rail wear, wheel wear and motor wear. On our double truck, we extend the spring base 3 feet wider, thus doing away practically with oscillation of the car, which is also very hard on the rail, wheel and motor.

SECRETAY HANNA—Can you tell the gentlemen present anything about the new electric heater we were talking of this morning?

MR. COOKE—Yes, just a little. The gentleman representing the heater expected to be here. He is an old school friend of mine, and that accounts for the interest I take in it. It was invented in Minneapolis. I have one in my house in the laundry. I take off the burner in the house and connect the wire and my laundress irons all day by means of this heater. The iron only gets so hot; it can't get any hotter, and it holds that heat a long while.

He has arranged a heater for a street car. I am sorry he is not here to explain it himself. It is merely a ribbon that runs along under the edge of the seat, I think about 6 or 8 inches wide and possibly a half or three-quarters of an inch thick, and with the current from the trolley, he heats the car perfectly to any degree of heat that is necessary. There is a button attachment at the motorman's command, so that he can give the car quarter heat, half heat, three-quarters heat or full heat, just as the demands of the weather may require. I merely make this statement in behalf of my friend, who has just recently taken hold of it, and who expected to be here to-day and give you an exhibition of it.

MR. C. B. FAIRCHILD, associate editor of the *Street Railway Journal*, N. Y., then addressed the convention by invitation as follows: I am very glad to have the opportunity of looking in your faces and of making myself known to you at this time. The hour is too late for me to enter into much of a discussion. I would like, however, in the first place, to disabuse your minds of

one thing. The street railway men seem to think that the technical press are very much on a par with the reporters of the daily papers, and sometimes you have been afraid to let us into your meetings and afraid to talk before us as you would among yourselves. Now, we wish very much that you would regard the technical press—at least the paper that I represent—not as a newspaper watching you, to pick flaws in your work and criticise you unfavorably, but as one working in the interests of the street railway companies. We would like to have it understood that we are, to all intents and purposes, a street railway company, interested in the same line of work you are interested in, and that your interests are our interests; that we come to your meetings, not merely as repor ers, but to learn and to publish that which will be of benefit to you and others. You need not be afraid of our publishing anything that is said in confidence among yourselves.

Now, just one word in regard to conventions, and particularly in regard to the Ohio convention. Those of you who have read the *Street Railway Journal* recently, have probably noticed that we are urging that more attention be given to these conventions. It seems to us that you do not fully appreciate what a power you might be in this State if all the street railway people felt obligated to be present at these meetings, or at least to contribute papers and take hold of this matter in earnest and place this Association on a solid foundation.

We hear a great deal of complaint, Mr. President, about unfair legislation, both from State and municipal authorities. I believe that if there is any more unjust or unfavorable legislation by which the street railway men suffer, that they will have themselves to blame for it. I believe that with proper organization among the street railway men of the State, they could influence legislation; or at least stop unfavorable legislation against street railway companies. It seems to me that the most important object to be attained by this convention is to secure some remedy in this direction. Take up this subject as was suggested in the papers read at the national convention last year and this year by Mr. Scribner, and pursue it in the line which he has indicated. Present the matter to your legislature and keep it before them until you have secured your rights. Remember the old adage "They have rights who dare maintain them." If you dare maintain your rights, undoubtedly you can get them.

You are a power and by united effort you can get justice at the hands of your law makers and make them to understand that you are determined to make your business more pleasant, more prosperous and more satisfactory to yourselves and to the community (applause). There is a great deal which might be said upon this subject. I simply speak by way of suggestion. I do not think anyone should go away from here feeling that this Convention has been a failure by any means, but let each member see to it that the interest which has been manifested this afternoon be continued and increased among all the street railway men of your State, so that at next year's Convention you will have a large meeting and one that will exercise a salutary influence over law makers. I hope your meetings will continue to be profitable and pleasant.

PRESIDENT STEWART then asked if Mr. Beggs or Mr. Lewis, representing the Edison General Electric Company, were present and desired to be heard.

MR. WILLIAM HAND responded to the call of the Chair and stated that to his regret neither Mr. Beggs nor Mr. Lewis was present, but that as he was working in the interest of the Edison General Electric Company, as an electrical expert, he would like to state that he had just completed the installation of the Glenwood and Green Lawn Street railway, of Columbus, Ohio, extending about four miles west from High street, with five cars, with the Edison system. The road has been in operation over two months and the repairs on the cars during that time had not amounted to one dollar; there had not been an armature taken out of any of the cars.

PRESIDENT STEWART then, after putting the motion to the Convention, declared the Association adjourned to meet at Akron, Ohio, on the second Wednesday of November, 1891.

CONVENTION NOTES.

ONE of the most entertaining features of the convention was the special *Street Railway Gazette* car from Chicago, carrying the following party of gentlemen to Columbus: Payson K. Andrews, of the Brill Car Co.; W. J. Cooke, of the McGuire Mfg. Co.; A. H. Englund, of the Electric Merchandise Co.; D. F. Morris, of the Milliken Pole Co.; C. K. Harding, of Atlantic, Ia.; R. M. Johnson, of the Northern Car Co.; John N. Reynolds, of the *National Car and Locomotive Builder* "*Supplement*;" D. B. Dean, of *the Electrical Review*; J. B. O'Hara, of *The Western Electrician*; W. Forman Collins, of THE ELECTRICAL ENGINEER. The car arrangements were in the hands of E. V. Cavell, editor of the *Street Railway Gazette*, and S. L. K. Munro, manager of the same journal, the former of whom made a most perfect "quartermaster" on the occasion and both gentlemen laid themselves out to entertain and amuse the party and their efforts were highly successful.

On Wednesday, at 7:30 p. m., a banquet was held at the Columbus Club, in its handsome dining room through the kindness of General Manager Sheldon. It was attended by the street railway men, supply men and representatives of the technical press. A most enjoyable evening was spent and some first rate speeches were made. The model of the Milliken pole decorated with smilax adorned the table as the centre piece. An elegant repast was served accompanied by exquisite vintages, and all expressed themselves delighted with their sojourn in Columbus.

THE DETROIT ELECTRICAL WORKS were ably represented by Mr. Charles A. Benton, who exhibited a very beautiful working model of their motor and truck equipment. The motor is of the well known "single motor" Rae pattern as fully described in a recent issue of THE ELECTRICAL ENGINEER, and possesses some very important and novel features. The truck was made by the Sheffield Velocipede Car Co., of Three Rivers, Mich., and is provided with rigid bearings on the non-oscillating principle, constructed of two frames with springs equally distributed throughout their entire length. It is made of wrought iron and amongst the merits claimed for it are adaptability to all systems of electric propulsion, superior design and workmanship, easy riding, non-oscillation, and freedom from tilting motion, strength, durability and economy. Mr. H. F. Probert, M. E., the inventor, was in attendance explaining its many advantages.

THE ELECTRIC MERCHANDISE COMPANY, of Chicago, were represented by the versatile secretary and treasurer of the company, Mr. A. H. Englund, who showed some very handsome rawhide pinions, various forms of pullover brackets and other devices for electric street railway work, and the Englund centre curve insulator, a new and meritorious device which is meeting with universal success and sells at sight. The street railway men were deeply interested in the various specialties shown, the advantages of which Mr. Englund showed up in a most picturesque and entertaining manner.

ILLINOIS ELECTRIC MATERIAL CO.—The interests of the Illinois Electric Material Co., of Chicago, were looked after by Mr. Ernest L. Clark, their well and favorably known secretary. Mr. Clark had numerous samples of their street railway devices, among others, the Murray overhead switch which attracted great attention and many words of the highest commendation from all who saw it, including some who are using it on their roads. A new pole ratchet also elicited considerable satisfactory comment. Mr. Clark was also busy as regards poles and was walking around with a large contract for wooden poles.

MR. D. FORSYTHE MORRIS, the Chicago manager of the Milliken Pole Co., brought with him a very handsome model of these poles, which are meeting with such success for ornamental street railway construction in cities. More than 7,000 of these poles have been sold in the past four months, and Mr. Morris states that he is ready to supply any quantity.

MR. CHAS. K. HARDING, president of the Harding Electric Railway Company, of Atlantic, Iowa, was busily engaged during the convention in explaining his new underground conduit system which possesses some highly ingenious and advantageous features. Mr. Harding will have his system in practical operation in the very near future, when undoubtedly some important developments of this method of operating electric street railways may be expected.

MR. J. S. COLLINS, of the Meaker Manufacturing Company, had on exhibition in the hotel one of his new fare registers operated mechanically, which is being largely used on street railways.

ELECTRICITY IN THE NAVY.

Commodore G. Dewey, Chief of the Bureau of Equipment, in his annual report to the Secretary of the Navy, says: "The lighting of ships of war by electricity, which was inaugurated by this Government, has now become so essential that no war ship is considered complete which is not so lighted. During the year substantial progress has been made in the development and advancement of the system, which is being employed in the new ships, and progress abroad has been critically noted. Electric lighting plants have been installed on board seven vessels, and the work of installation is actively progressing upon four others. Special attention has been given during the year to the subject of means of interior communication on shipboard, and a telephone system is soon to be added experimentally to other devices in use on board one of the new cruisers. Night signalling by electricity has also been, and is still actively, under consideration, and it is believed that a system will have been devised in the near future which will meet the increasing necessity of the service in this respect. The great importance of an adequate method of communication at night between ships of a squadron or fleet makes necessary the utmost care in the consideration of the subject."

INVENTORS' RECORD.

DIGEST OF ELECTRICAL PATENTS ISSUED NOV. 18, 1890.

Alarms and Signals:—

Push-button, H. Von Kohler, 440,818. Filed May 31, 1890.

Designed for simplicity, cheapness and proper protection of contact points.

Conductors, Conduits and Insulators:—

Electric Conduit, W. J. Brewer, 440,822. Filed July 15, 1890.

Specially applicable to electric railways. Conduit with conductor of two plates or rods insulated from each other and surrounded by a flexible rubber tube, contact pieces, held in position by springs, passing through the rubber tube and projecting upwards into slot to be actuated by trolley. Adapted, also, to single conductor in conduit. Rail having a bracket piece, forming, with the rail, a conduit, in combination with the above.

Underground Wire System, E. Verstraete, 441,043. Filed Feb. 21, 1890.

An underground conduit system for electric wires. An iron structure with supporting bars upon each side to hold insulating strips for wires or cables and with a passageway and a railroad track in the centre of the conduit for the transit of reels. Conduit slotted at the top which is flush with the road-bed throughout its length, for convenience in inserting and removing wires; slot normally closed by sectional caps.

Dynamos and Motors:—

Electric Collecting Device or Brush, H. P. Brown, 440,691. Filed June 6, 1890.

Brush or contact-maker composed of graphite and clay mixed together.

Electric Motor, C. E. Dressler, 440,699. Filed April 10, 1890.

A cylindrical field magnet with pole pieces at each end and wound on the outside with insulated wire, a rotary armature core in the axis of field magnet within an interposed coil of insulated wire and with pole-pieces at each end. The coils being so wound that the field magnet and armature when energized have opposite polarity at each of their ends, whereby the combined energy of the whole of both field magnet and armature is exerted attractively at the ends to rotate the armature.

Electric Motor, H. B. Pullman, 440,776. Filed Aug. 16, 1890.

To secure equipoise of the armature on its centres, and to obtain a nicety of adjustment of the pole-sectors of the field magnet.
Armature has a counter-balance, adjustable on the web of the armature to and from the axis of the armature.

Yoke and Brush-Holder, F. B. Rae, 440,817. Filed Aug. 9, 1890.

Designed to be easily applied, adjusted or removed.
Yoke provided with collar made in two complementary portions, each portion somewhat smaller than half the circumference of the bearing therefor, and connecting devices between the two parts.

Electric Motor, L. Bock, Jr., 440,821. Filed Aug. 20, 1889.

A reciprocating motor; a series of solenoids with a converter for reducing high tension alternating currents, the coils or solenoids of the motor being in the secondary circuit of the converter.

Dynamo Electric Machine and Motor, F. V. Anderson and J. O. Girdlestone, 440,908. Filed May 13, 1890.

Design and construction for reduction of weight and for simplicity and economy of manufacture; also, to reduce the magnetic resistance of the air-spaces around the armature to a minimum.

Generator for Pulsating Currents, C. J. Van Depoele, 440,977. Filed April 17, 1890.

First claim as follows:
1. A system of generating rising and falling currents, comprising a revolving armature of the continuous-current type rotating in a suitable field of force, and means for causing the magnetism of said field of force to rise and fall, reacting upon the armature to produce defined rising and falling currents therein.

Lamps and Appurtenances:—

Electric Arc Lamp, E. Thomson and E. W. Rice, Jr., 440,662. Filed Jan. 3, 1884.

A high resistance derived circuit magnet, a feed-controlling mechanism to suspend or normally hold the carbon-carrier in proper relation to the opposite carbon, a support for the feed-controlling mechanism actuated by the derived circuit magnet in one direction to feed and in the opposite direction by a suitable retractor, a starting circuit, a circuit-controller with which a part moving with the feed-controlling lever engages when the lever is in an extreme retracted position, and a spring for throwing the circuit-controller out of range of the movements of the lever when the lamp mechanism has been brought to operative position.

Electric Arc Lamp, E. Thomson and E. W. Rice Jr., 440,663. Filed Jan. 3, 1884.

A high-resistance derived circuit magnet whose armature lever supports the carbon-electrodes and is actuated in opposite directions by the magnet and by a retractor, a starting coil on the core of the derived circuit magnet, a circuit controller for throwing the starting core out of action, and a magnet in the carbon branch and in a circuit independent of the derived circuit magnet for operating the circuit controller.

Apparatus for Flashing Filaments, H. Lemp, 440,759. Filed Feb. 1, 1889.

Flashing current automatically cut out of circuit when the filament reaches the desired resistance. Second claim follows: An apparatus for flashing filaments for incandescent lamps, embodying a circuit containing the filaments immersed in a hydrocarbon bath, a low variable-resistance circuit normally shunting the same, a second circuit of higher resistance containing an electro-magnet in a constantly-closed circuit, and contact devices in said low variable-resistance circuit controlled by the operation of the aforesaid magnet, substantially as described.

Incandescent Electric-Lamp Socket, J. W. Collier, 441,059. Filed Nov. 16, 1889.

Made from a plastic non-conducting material having solidly molded and embedded in it the holder contacts and the separate wires for connections, and having a solid hermetically closed base.

Measurement:

Electric Meter, S. Z. DeFerranti, 440,627. Filed Oct. 9, 1888.

First claim as follows: 1. In an electric meter, the combination of a rotating armature, registering mechanism driven thereby, a coil carrying the current to be measured and within the field of which the armature rotates, and a compensating coil of higher resistance also acting to produce rotation of the armature.

Metallurgical:

Process of Magnetically Concentrating Ore, G. Conkling, 441,060. Filed Oct. 12, 1889.

First coarsely crushing ore to a size required by its natural granular formation without reducing any considerable portion of the ore to dust, then concentrating the ore by the action of magnets, then screening the concentrate to separate the richer ore, then re-crushing the ore refused by the screen, and finally concentrating the re-crushed ore by the action of the magnets.

Metal Working:

Electric Welding Apparatus, H. Lemp, 440,641. Filed June 13, 1890.

Invention consists, essentially, in constructing the apparatus with a plurality of secondaries in the transformer arranged parallel to one another. The several secondaries may have the same or different iron cores or magnetic circuits. Adapted to apply current to the same or to different parts of the work in multiple arc.

Electric Welding Transformer, H. Lemp, 440,640. Filed Apr. 16, 1890.

Welding apparatus designed particularly for classes of work in which the areas of material to be heated at once are extended or subdivided, and which are liable to heat unevenly. Secures uniform heating at different parts of the work by supplying them from different sources of energy and regulates the different sources independently. Specially adapted to the formation of the two separate welds or joints simultaneously in parallel. Second claim follows: 2. The combination, with a compound transformer comprising two or more secondaries and corresponding primaries therefor applied at different parts of a common iron core and having magnetic bridges from one side to the other of the core, of means for regulating the current-flow in the primaries independently of one another.

Method of Electric Welding, E. Thomson, 440,664. Filed May 15, 1888.

Invention consists essentially in the repeated application alternately of a heating current and pressure to the pieces to be welded.

Miscellaneous:

Electric Switch, E. T. Barberie and J. DesBrisay, 440,614. Filed Apr. 8, 1890.

A fixed electrode, pair of movable electrode arms adapted to grip the fixed electrode, the latter operated by hand through a pair of links.

Lightning Arrester, E. W. Rice, Jr., 440,654. Filed Aug. 15, 1889.

First claim follows: 1. The combination, with the electric apparatus to be protected, of a lightning-arrester in a branch to earth of low self-induction, and a self-inductive coil interposed between the said apparatus and the point of connection of the lightning-arrester.

Electric Cut-Out, G. H. Alton and E. W. Rice, Jr., 440,685. Filed Nov. 21, 1889.

A fuse wire mounted between terminals upon an insulating plate, safety fuse clips or electrodes made as spring jaws, which project from their supports so that their openings will be in position to permit a fuse to be slipped in edgewise between them by a movement of such fuse bodily toward the support upon which the jaws are mounted.

Electric Switch, C. A. Pfluger, 440,720. Filed Jan. 15, 1890.

Two vertically tilting levers insulated from each other, one being longer than the other, the longer being pivoted midway of its length and the shorter in the same horizontal plane but at its extremity, the pivotal points connected to the main circuit binding posts and the same levers adapted to engage contact points connected with local circuit.

Cross-Over Block, F. Bathurst, 440,753. Filed March 31, 1890.

Device for securing and insulating wires at points of crossing.

Electric Switch, C. H. Herrick, 440,845. Filed Aug. 19, 1890.

Rotary "snap" switch.

Ceiling Block, D. A. Tompkins, 440,944. Filed Dec. 31, 1889.

Cut-out for incandescent lamp circuits.

Thermal Protector, H. V. Hayes, 441,066. Filed July 17, 1890.

For the protection of the instruments in telephonic and telegraphic circuits not only from the very strong currents of light and power circuits, but from lesser "sneak currents" that are dangerous to delicate instruments but not strong enough to operate ordinary protectors now in use.
A movable switching arm or contact piece, tending to connect an alternative circuit with main line, held in disconnection by a stop of easily fusible metal and a heat concentrating device, as a coil of high-resistance wire, for directing the heat developed by a current of undue strength in the main line upon the fusible stop.

Railways and Appliances:

Trolley-Arc for Electric Railways. E. Thomson, 440,665. Filed Mar. 5, 1889.

Trolley-arm designed particularly for use where the distance between the vehicle and the wire or conductor varies materially; and to cause the roller or contact to be carried directly over the centre of the length of a car when the wire is overhead. A double-jointed arm, the upper section of which, carrying the trolley, inclines in an opposite direction to the lower section which is attached to the car, the two arms resembling a toggle joint; a spring attached to the lower end of the upper section of the arm tending to expand the angle between the two arms, and thus to keep the trolley in contact with a conducting wire at various heights and over the longitudinal centre of the car.

Signaling Apparatus for Electric Railways, F. F. Loomis, 440,881. Filed Mar. 15, 1890.

An auxiliary wire is connected with the feed wire and provided with signaling apparatus arranged to be actuated by the current from the feed wire when a ground connection is made with the auxiliary wire.

Trolley for Electric Railways, C. A. Lieb, 440,814. Filed June 13, 1890.

Trolley-pole vertically supported by springs placed on opposite sides of the base and in the same horizontal plane therewith; connections between the springs and the pole by which it is elastically supported against pressure in all directions.

Electric Railway-car Motor, L. F. Baker, 440,686. Filed July 1, 1889.

Sleeving the motor or a part attached to it to the car axle at one end and supporting the motor at the opposite end by an elastically sustained bar, which is engaged by a projection upon the motor or motor frame, the projection sliding freely on the supporting bar.

Electric Railway Car, W. S. Belding, 440,699. Filed Apr. 21, 1890.

Continuous rotation of armature of motor, whether car be in motion or stationary. Means for engaging and disengaging armature shaft with wheels or axles of car. Propulsion of car in either direction without changing the direction of rotation of motor.

Electric Motor and Generator, C. E. Dressler, 440,700. Filed May 12, 1890.

A machine to act simultaneously as both motor and generator. A field magnet or magnets, a rotary electro-magnet armature and an induction coil helically wound at right angles to the armature's axis and inductively excited by the armature.

Electric Motor Mechanism, S. E. Mower, 440,717. Filed May 8, 1890.

Relates particularly to speed reducing mechanism. Motor has its armature secured to a sleeve loosely mounted on the axle; speed-reducing mechanism consists of a disc fast on the sleeve, a gear fast on the axle, a gear loose on the armature sleeve, a shaft having bearings in the said disc and provided with a pinion in mesh with the gear on the axle and with a gear in mesh with the gear loose on the armature sleeve, a friction disc or drum loose on the armature sleeve and secured to the gear on the armature sleeve, a friction strap to engage the friction disc, and means to engage the strap with the disc.

Electric Motor Mechanism, S. E. Mower, 440,718. Filed May 10, 1890.

Similar in purpose to above. Motor has its armature secured to a sleeve loosely mounted on axle; speed-reducing device consists of a gear fast on the armature sleeve, a disc mounted on the axle and having a recess in its periphery, a shaft carried by the disc, a movable box for said shaft, and a gear fast on the axle, and a friction strap encircling the movable box and disc.

Underground Conductor, E. Verstraete, 440,780. Filed Feb. 21, 1890.

For electric railways. A conductor grooved on its under side for the passage of a trolley, and insulated and protected at top and sides.

Trolley or Plow for Electric Railways, E. Verstraete, 440,781. Filed Feb. 21, 1890.

Weight-actuated levers, contact-bearings carried by the levers, and a frame to which the levers are pivoted.

Overhead Conductor for Electric Railways, R. D. Cushing, 440,789. Filed Dec. 16, 1889.

A bifurcated insulating guard or covering enclosing the upper surface of the conductor and partially overhanging it, leaving its under surface exposed to the trolley wheel.

Electric Railway, S. Trott, 440,905. Filed April 26, 1890.

Protection of contact brushes, in conduit system, from falling moisture. Contact-brush of carrier or plow protected by the expansion of insulating material in the form of a hood immediately above the brush. Applied to either single or double conductor system.

Railway Signal, J. W. Riggs, 440,925. Filed Aug. 31, 1890.

For the automatic signaling of trains approaching a bridge endangered or of which the structure has been carried away by a flood. Signal operated by a float when water has risen sufficiently to endanger the bridge.

Railway-Signaling Device, J. W. Riggs, 440,926. Filed Sep. 12, 1889.

To prevent accidents to trains approaching burning bridges. Thermostatic signal.

Railway Signaling System, J. W. Riggs, 440,927. Filed Sep. 12, 1889.

To prevent derailment of trains when a switch is out of place.
1st claim is as follows:
1. The combination, with a track the rails of which are arranged in sections and to break joints and are insulated from each other at their meeting ends, an insulated conductor, and a switch in said track, of a switch-stand, mechanism contained therein for actuating the switch, a contact-piece and connections from such piece to the track and insulated conductor substantially as and for the purpose specified.

System of Electric Transmission of Power, C. J. VanDepoele, 440,976. Filed May 10, 1886.

Utilizes the momentum of electric railway cars, as when running down a grade, for the generation of current, through an organization which permits the motor to be used as a generator and to add the current produced by it to the main current of the line.

Train-Signal for Railroads, W. D. Sheldon, 441,030. Filed June 15, 1889.

Signaling the approach of a train in advance; signaling in advance and in the rear of a train the position of the train; and lighting the road-bed in advance of a moving train.
Along the track of a railroad a circuit of two conductors with a dynamo and a series of electric lamps, one terminal of each lamp connected with one of the conductors and the other terminal connected through a circuit-closing device with the other conductor, operative connections between the circuit-closers by which when one circuit-closer is actuated by the passage of a train its lamp is lighted and the other circuit is opened and its lamp extinguished.

Train Signal, W. D. Sheldon, 441,031. Filed Sept. 20, 1889.

A switch-operating mechanism operated by a passing train and by which an electric current is applied to an electric motor actuating a day-signal some distance in advance of a train.

Railroad-Gate, W. D. Sheldon, 441,032. Filed Sept. 20, 1889.

A railroad crossing gate operated by an electro-motor the connections of which are automatically operated by the passage of a train.

Train Signal for Railroads, W. D. Sheldon, 441,033. Filed May 15, 1890.

Lighting the tracks of railroads in advance and in the rear of moving trains. Lamps normally short-circuited; passing train breaks the short circuit and lights the lamps on a given section of the road.

Lighting Railroads, W. D. Sheldon, 441,034. Filed May 15, 1890.

Lighting a railroad and signaling the approach of a train. Sections of electric conductors suspended over the track and connected with electric lamps; a source of electric energy carried on the train and connected by wipers or trolleys with the overhead conductors.

Electric Railway Signal, W. H. Waddell, 441,044. Filed Oct. 21, 1889.

Two separate and distinct conductors located on opposite sides of the track in overlapping sections insulated from each other, a signal alarm and signal source of electrical energy on the locomotive.

Telegraphs:—

Telegraphy, P. B. Delany, 440,766. Filed May 11, 1886.

Relates to synchronous-multiplex telegraphy.
Places the correction-receiving segment sufficiently behind the position of the correction-sending segment as to compensate for the retardation upon a line of considerable length.

Synchronous Telegraphy, P. B. Delany, 440,767. Filed July 30, 1886.

First claim is as follows:—
1. The combination of the several segments for correction, messages, and grounding, said segments being arranged in a circle independently insulated and provided with independent binding posts or contacts, so that they may be independently connected, as desired.

Multiplex Telegraphy, P. B. Delany, 440,768. Filed July 30, 1886.

Running the circuit-completer at the transmitting end ahead of that at the receiving end by a distance proportional to the time of retardation of the line; sending impulses into the line in succession in one direction only and irrespective of whether each preceding impulse has reached the receiving station, and receiving such impulses as arrive at the distant end of the line in their proper succession, according to the time of the line.

Telephones and Apparatus:—

Calling Device for Clock Telephone-Lines, J. A. McManman, 440,898. Filed March 21, 1890.

Central-station apparatus for use upon telephone lines containing a number of subscribers.
A clock mechanism carrying a revolving dial plate, a series of contact plates beneath said dial plate, each wired to a spring jack and the spring jacks wired together to a generator; a circuit-making and breaking device connected with the dial plate.

SOCIETY AND CLUB NOTES.

ELECTRICAL DEPARTMENT—BROOKLYN INSTITUTE.

On Friday evening last, Nov. 21st, Dr. S. S. Wheeler, the expert of the New York Board of Electrical Control, delivered a most able and interesting lecture on "Some Applications of Electricity." It was fully illustrated by a large variety of experimental demonstrations.

TELEGRAPHERS' MUTUAL BENEFIT ASSOCIATION.

The annual meeting of the Telegraphers' Mutual Benefit Association was held at 195 Broadway, N. Y. City, November 19th, Vice-president Young in the chair. President Merrihew's report referred particularly to the membership question. He said among other things: "Your especial attention seems to be necessary in the direction of increasing the membership—such increase should be steady and gradual. The agents, who are all busy men, should neither be expected nor depended upon to do all the work. It is a matter of personal interest with the members, each of whom should be an active solicitor, interesting his fellow workers, especially the young men, in the history and objects of the Association; and it should be the pleasure—as it is the duty—of every member to aid in increasing the membership. The fraternal co-operative spirit exhibited by the founders of this Association, 23 years ago, should be renewed by the young men of the present, and the Association pushed ahead with vigorous enthusiasm. In the early days, as many of you will remember, the obstacles were many and the difficulties great—to-day, the young men have a perfect organization, a good system, a liberal contract and a reserve fund of almost $100,000—a right good start." Secretary Fleming's report showed that out of a total of 155 applications received, 149 were accepted, 4 rejected and 2 withdrawn; 28 deaths were reported during the year and 99 members lapsed, leaving a net increase in membership for the year of 22 members. The treasurer's report showed receipts from assessments and initiation fees, $41,559.75; from interest, $5,508.57. The sum of $13,000 has been added to the reserve fund, bringing the total par value of that fund to $99,508.92. The following named gentlemen were elected as officers for the ensuing year: President, James Merrihew; vice-president, W. H. Young; secretary, Thomas E. Fleming; treasurer, G. W. E. Atkins; executive committee, James Merrihew, New York, G. W. E. Atkins, New York, W. B. Gill, Philadelphia, Thomas E. Fleming, New York, W. H. Jackson, New York, S. C. Mason, Chicago, W. H. Young, Washington, Joseph L. Edwards, New York, C. W. Hammond, St. Louis; auditing committee, S. S. Garwood (chairman), Philadelphia, W. J. Dealy, New York, M. J. O'Leary, New York.

After the meeting, the Magnetic Club gave its opening dinner, at Martinelli's, over 100 gentlemen attending. Dr. Norvin Green was one of the guests of the evening. A most enjoyable time was spent.

The Short Electric Railway Co. report the following contracts for the two weeks of November (to the 15th) for electrical equipment: The Schuylkill Electric Railway Co., Pottsville, Pa.; the Watervliet & Turnpike Railway Co., Albany, N. Y.; the Texarkana Street Railway Co., Texarkana, Ark.; the Lindell Ave. Railway Co., St. Louis, Mo.; the Syracuse & Onondaga Railway Co., Syracuse, N. Y.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

"STANDARD" INSTRUMENTS FOR ELECTRICAL TESTING.

WE illustrate, in the accompanying engraving, a new form of ammeter and voltmeter designed especially for central station, laboratory and battery work, manufactured by the Electrical Supply Manufacturing Company, of Manchester, N. H., and sold

"STANDARD" DIRECT-READING AMMETER.

exclusively by the Standard Electric Supply Company, of Boston. These instruments are manufactured on the highest plane as to accuracy and finish, and are carefully calibrated before leaving the factory. It has been the aim of the manufacturers to supply a thoroughly reliable instrument at a reasonable figure, and from the success which these instruments have attained, they have achieved the desired result. The readings, both on the voltmeters and ammeters are direct, and the needle is very dead-beat in its action. The instruments are made for various purposes, and they can be procured either for fractional readings of a volt or ampere, such as for battery work, or for very high readings, such as for street railway work. The goods have now been on the market long enough to prove their value, and the Standard Electric Supply Company are already doing a brisk business in supplying the demand.

HEAVY SHIPMENTS OF WESTINGHOUSE APPARATUS.

In order to fill the rapid demand for the various manufactures of the Westinghouse Electric and Manufacturing Company that firm has lately been obliged to augment considerably its facilities for shipping the goods from the works to the different railroad stations in the city of Pittsburgh. A number of wagons are constantly engaged in hauling motors and machinery, but as the company's own teams were not sufficient some of the local express companies had to be asked to aid in the work.

During the month of November, the shipments of the company will amount to 40 alternating current incandescent dynamos, aggregating a total capacity of 30,000 16 c. p. lamps. To this must be added 1200 alternate current meters. The demand for this measuring device of the Westinghouse Electric and Manufacturing Co. has for months been particularly pressing, and the detail department at the Garrison alley shops, where these meters are manufactured, is taxed to its utmost capacity. The same remark holds good in regard to the Westinghouse converters, the high efficiency of which has created a very favorable impression for them wherever they have been used. The company is in almost daily receipt of letters and communications from places where the converters have been introduced, which speak in exceedingly flattering terms of their operation. It is stated, that during the entire time in which the company has manufactured and sold these converters, not one has ever been returned for fault of construction or inefficiency. This, it must be acknowledged, shows a remarkable record for a piece of workmanship, of which thousands are now in use throughout the world.

It is now a little more than two months since the electric street railway in Lansing, Mich., the first road operated by the Westinghouse electric street railway system, started. Since then the Westinghouse company has completed the equipment for twelve roads, which to-day are running to the utmost satisfaction of the purchasers and manufacturers. A few days ago, the managers of the Lansing road, in a letter to the Westinghouse company, stated, that although they had a number of difficulties to surmount in the construction of the road, they were glad to say that everything had been overcome, and that they felt positive the Lansing electric railway is to-day the best equipped street railroad in this country. It must not be forgotten, however, that while speaking of difficulties, that term in no wise referred to the motor equipment of the road. In fact, as far as the Westinghouse motor is concerned, it is said that the apparatus runs as smoothly and noiselessly to-day as it did on the first day it ran along Main street, Lansing.

The Westinghouse Electric and Manufacturing Company has now increased its capacity of the motor department to an extent which enables the firm to manufacture and ship 100 motors per month. The company has at the present time 50 new roads under process of construction, and as the facilities and the working capacity of the motor department are constantly increased, it is expected, that within a very short time, the supply will be equal to the current demand.

STAR ELECTRIX CEILING CUT-OUT.

We illustrate herewith, in Figs. 1 and 2, a new ceiling cut-out, which embodies several improvements. It is manufactured by the Star Electrix Company, of Philadelphia, who are pushing its sale together with their other specialties. This is claimed to be the neatest and best designed ceiling cut-out which has appeared up to date. The main wires are screwed just 2¼ inches apart, which avoids bending the wires at the cut-out. It is easily wired,

FIGS. 1 AND 2.—THE STAR ELECTRIX CEILING CUT-OUT.

yet there are no bungling screws or castings on the side to disfigure it. The cut-out is said to be meeting with great favor already, with supply men and contractors.

RECONSTRUCTION WORK AT LANCASTER, PA.

The reconstruction work by Pattison Bros., of 135 Broadway, N. Y., at Lancaster, Pa., has given such entire satisfaction that the same parties have put the Williamsport station into this firm's hands for a similar treatment. Mr. Chas. E. Pattison is in charge of the work and has already begun the alterations and repairs.

EUREKA TEMPERED COPPER CO.

The Eureka Tempered Copper Co., of North East, Pa., has issued a neat little pamphlet giving full details as to the qualities of its product and including a large number of excellent testimonials. This admirable material is now beginning to be appreciated as it deserves by electrical and engineering concerns, for commutators, trolley wheels, bearings, boxes, &c.

EXHIBIT BY W. H. GORDON & CO. AT THE AMERICAN INSTITUTE FAIR.

Messrs. W. H. Gordon & Co., 115 Broadway, have on exhibition at the fair the Automatic Clock Co.'s specialties. The principal attraction in the exhibit is the automatic cut-out clock for cutting out incandescent lights in stores or show windows at any given time. These clocks have a switch attachment and are particularly desirable for stores wishing to advertise by having their show windows brilliantly lighted during the evening. The other clocks in the exhibit have attachments for ringing bells in servants' rooms, opening dampers on furnaces, in short, doing automatically many of the things about a residence night and morning, even to feeding horses. A clock was shipped to Atlanta, Ga., recently, to unlock a door at a set hour. The Gardner Governor Co. uses one to open two heavy iron doors on their japanning ovens; a Lockport firm, to turn off a gas meter; while the Syracuse Gas Co. uses one to turn off their large Lungren burner.

Orders for the clock and cut-out for incandescent lights are coming in quite freely, and merchants are beginning to recognize their utility, convenience and economy.

THE HUNT ENGINEERING CO.

A great many enterprises have recently sprung up with the sole purpose of electrical construction and taking charge of the commercial application of electricity, and it is a practice of the large manufacturing concerns to let their construction out on contract, and where reliable parties have been entrusted with this task, it has proved the best policy.

The Hunt Engineering Co., 177 Montague street, Brooklyn, to judge from their success in the past, are destined to take a prominent part in the construction field. They will manufacture the goods which they need with the exception of dynamos, lamps and instruments. At present they have under construction the Norwich Opera House, Norwich, Ct., an isolated 650-light plant; Republican Press Association, Concord, N. H., an isolated 300-light plant; the Cordis Mills, Milbury, Mass., an isolated 300-light plant; central station at Dover, N. J., 1,000 lights; central station at Jamaica, L. I., 2,000 lights, both of the latter being alternating National system. They are the patentees of an improved key socket, the patent for which was granted within a few days. The men controlling this company are well posted on all the details of the business. G. W. Hunt is president, A. E. Rich, general manager, Alex Henderson, superintendent of construction, DeWitt N. Cole, civil and consulting engineer.

THE AMERICAN TANNING CO.

The American Tanning Co., P. O. Box 1189, New York City, has just been organized and is now introducing the Worms and Balé process of electric tanning described on page 587 of this issue. The method is a very simple one and the economy of the process is such that electric tanning may be looked forward to as a well established improvement in the art. Besides the enormous saving in time, an increase of over 10 per cent. in weight, as compared with the old method is obtained in the finished product. Information can also be obtained from Mr. A. Cuyas, 80 Wall St., the agent of the inventors.

JEROME KIDDER MFG. CO.

DR. H. S. HERRICK, of Hamilton, Nev., in a recent letter to the above company, of this city, says: "This is the sixth battery I have had of your manufacturing during the last twenty years. There have been any amount of electrical machines in this Western country during the last decade. In my practice I am willing to acknowledge that Kidder's battery far excels any other for durability and medicinal purposes."

J. G. WHITE & CO.

A new firm of electrical engineers and contractors has come into existence under the above style, with offices at 50 Broadway, this city. The principal, Mr. J. G. White, was general manager of the well known Western Engineering Co., of Kearney, Neb., which made so many excellent installations in the West and was finally consolidated with other enterprises of the kind. The firm will make a specialty of electric railway work, and will contract to furnish complete equipments or separate details, without restriction as to system or manufacturer. They are ready to make bids on any plant, to be built or enlarged, and invite correspondence.

THOMSON-HOUSTON PLANTS IN THE WEST.

The Chicago office of the Thomson-Houston Co. reports the following sales of isolated plants: Schneidewend & Lee Co., Archer avenue and Halsted street, Chicago, 300 incandescent electric lights; Johnson Locke Mercantile Co., San Francisco, Cal., for the California Pumice Co., at Napa, Cal., 50 incandescent lights Fecker Brewing Co., 371 Dudley street, Chicago, 50 incandescent lights; Chicago Anderson Common Brick Co., town of Lyons, near Chicago, 13 arc lights; the McCormick Harvester Machine Co., an order for a 16 arc light second hand outfit for blacksmith shop; Compound Lumber Co., 70 incandescent lights for Hegewison, Ill.

THE ROBERTS ELECTRIC LAUNCH AT TORONTO, CAN.

The staid everyday citizen who happened to be out boating on the bay on Saturday afternoon, Oct. 25, says the *Toronto Mail*, was doubtless startled by the strange spectacle of a good-sized launch carrying fourteen men about with wonderful speed, apparently moved by some occult and mysterious power. There was no smokestack, no oars, and only a muffled whirr told that some machine furnished the power. The launch was driven by the Roberts storage batteries, and among the passengers were Mr. W. Roberts, the electrician; Mr. A. T. Anderson, Mr. Wilson, Mr. E. Radway, marine engineer, and representatives of the press. The yacht was built by Mr. Lorsch, of the Excelsior boat-house, from designs furnished by Mr. G. H. McFarlane, of the Roberts Storage Battery and Electrical Construction Company, 46 Adelaide street, west. The power was furnished by the Roberts storage batteries, driving a Kay shunt wound three-horse power motor. When connected in a series the batteries were capable of developing four-horse-power and driving the yacht at a speed of eight miles per hour. Coupled in multiple form the motor will develop three-horse-power, and the charge will last a whole day. The storage jars were of rubber, so that there was no danger from breakage, and the Toronto Electric Light Company will charge the cells at the rate of 20 cents per hour. With Mr. Roberts at the throttle, as the miniature switch might be termed, the yacht ran to Hanlan's point and back in 28 minutes. The screw was stopped, reversed, turned ahead by simply moving the switch. The trial trip was very highly satisfactory, and upon landing, Mr. McAulay, of Kingston, gave an order for a similarly equipped boat.

EMPIRE CITY ELECTRIC CO.

Driven by the great increase of business to enlarge its facilities, the Empire City Electric Co., of 15 Dey street, has now annexed the fine adjoining store to the west, and has broken an archway through for communication. The old and new stores are being handsomely decorated. The annex will be laid out in banking house style, for the bookkeeping purposes of the concern, and will be one of the most tasteful electrical offices in town. In spite of his recent severe illness, General Madden has been giving the extensions his personal care and direction.

JAS. W. QUEEN & CO.

The above firm have issued a very pretty little folder in tints, on their Ayrton & Perry magnifying spring ammeters and voltmeters. It is addressed to electrical engineers and central station superintendents, and dwells forcibly upon the chief characteristics of the instruments referred to.

ELECTRIC WELDING.

The Thomson Electric Welding Co., of Boston, Mass., is putting in an electric machine to weld ¼ inch steel for wire and rods for the Cleveland Rolling Mill Co. Mr. A. M. Bullard is superintending the work. A machine was put in by this company for the Rogers Typograph Co. and is giving great satisfaction.

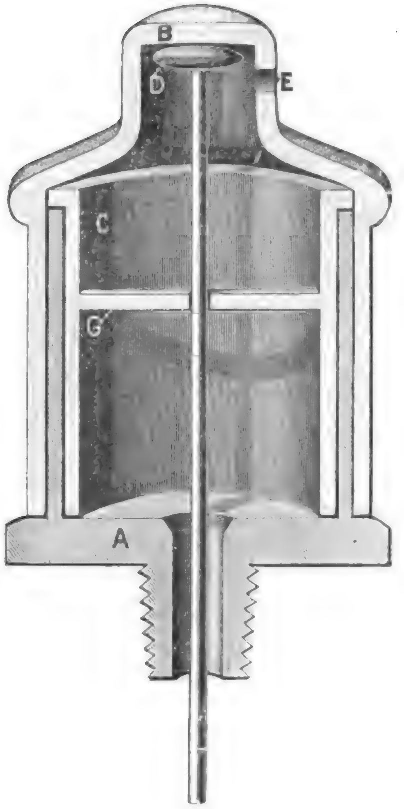
THE ECLIPSE CLUTCH WORKS, BELOIT, WIS.

The manufacture of friction clutch pulleys and other power transmission machinery, formerly conducted as a branch of the business of the Eclipse Wind Engine Co., of Beloit, has now been transferred to the Eclipse Clutch Works, a separate concern, by which it will now be actively pushed.

POWELL'S ELECTRIC CAR GREASE CUPS

An electric car motor being under the car floor, it is an important factor in such service that lubrication to the journal bearings should be prompt and quickly accomplished. The Powell car motor lubricator is expressly devised to accomplish this without a loss of time, even when the car is in motion. The cup, which is illustrated in the accompanying engraving, is constructed with a removable charging case, and is instantly removed and replaced when required.

To refill the cup, the hood B is pulled off and the case C withdrawn by inserting the finger under the guide bar G. The cup is then filled, the guide bar with its friction rod, replaced, and the cover returned. As the latter slides down the whole length of the chamber A, there is no possiblity of the cover being lost or



The Powell Electric Car Grease Cup.

shaken off while the car is in motion, and all dirt is rigidly excluded from the bearings.

This cup is manufactured by the Wm. Powell Co., of Cincinnati, O., the makers of the well known "Signal" dynamo oil cups, and sight feed lubricators.

THE BUFFALO ELECTRICAL SOCIETY.

This society continues to do a noble educational work, and has just issued its programme for the season of 1890-1. It embraces a variety of interesting topics, and the list of lecturers includes such well known names as A. C. Terry, W. Finn, Frank Kitton, M. Buell and F. P. Jones. The society is richly deserving of local support and of good wishes everywhere.

OBITUARY.—MR. H. H. JOHNSON.

We regret to announce the death of Mr. H. H. Johnson, who has been for a number of years superintendent of the Hartford Electric Light Co. Mr. Johnson was taken down with typhoid fever a little more than a week ago, and from the very first his life was despaired of. His career as a station superintendent has been a very successful one, and he was deservedly popular, having endeared himself by his uniform courtesy and good fellowship with a host of men who had occasion to have business dealings with him. His place will not be easily filled, and many in the years to come will miss his cheerful smile and hearty welcome. His funeral took place last Wednesday and was attended by large numbers of his friends, and numerous floral offerings were sent as the last signs of affection and good will.

NEW ENGLAND TRADE NOTES.

The Billings & Spencer Co., of Hartford, the well known manufacturers of drop forgings for electrical purposes, are building a large addition to their factory. Their business in commutator bars has never been so large as at present, and they have received some very large orders for these goods.

The Jewell Belting Co., of Hartford, have nearly completed their large addition to their present quarters. The addition consists of a large four-story brick building adjoining their present factory. The Jewell belt is becoming very popular for electric work, and they have at present on their books a number of orders for various electric light and power stations from all parts of the country.

The Standard Electric Time Co., of New Haven, Conn., are developing a large business in their Warner system of electric time clocks, and have recently licensed The Standard Electric Time Co. ,of Seattle, to operate in the States of Washington and Oregon. This company has been organized with a capital of $25,000 all subscribed and has already ordered about a ton of clocks, consisting of two regulators and 50 dials.

The Bryant Electric Co., of Bridgeport, have secured the exclusive rights of manufacture of double pole switches under the patents of W. B. Cleveland, which consists of the spiral spring attachment for the quick make and break of contact, out of control of the operator after passing a certain point. This ends the litigation on these patents.

Mr. O. S. Platt, of Bridgeport, Conn., is having quite a success with his switch, which he recently put on the market. The switch has met with general approval and Mr. Platt has had to double his capacity to keep up with the growing demand.

NEW YORK STATE NOTES.

The American Electric Supply Co., of 226 Pearl street, Buffalo, who have been in business only a few weeks, are enjoying unusual prosperity. They have already furnished a fine isolated plant in the building of The Snow Steam Pump Co., East Buffalo, are putting in a central station plant at Fredonia, N. Y., and have secured the contract to wire the new Cornell library building at Ithaca—which, by the way, is to be a $1,000,000 structure.

The Electric Engineering and Supply Co., of Syracuse, whose suite of offices in the Everson Building is equipped with everything, from a long-distance telephone to a live, pushing manager, is doing a rattling business. They are contemplating securing more commodious quarters for their warerooms, which, by the way, are centrally located in a three-story building on Water street. Syracuse and locality have long felt the want of a concern that will combine electrical engineering of the highest class with a full stock of staple supplies and specialties, and the city is certainly to be congratulated on now having such a company under the management of Mr. F. H. Leonard, whose past work for the Thomson-Houston Company in New York State is widely known.

ST. LOUIS TRADE NOTES.

The St. Louis Car Co. have erected a new building during the past summer to provide additional facilities for building electric cars. They are now building 30 electric cars for the Mound City R. R., of St. Louis; 30 electric cars for Quincy, Ill.; 15 for Springfield, Mo.; 15 for Rockford, Ill.; 15 for the Storage Battery Street Railway, New Orleans; 12 for Springfield, Ill.; 5 additional cars for the Union Depot R. R., of St. Louis, and 2 for Joliet, Ill.

The Laclede Car Co. are finishing up an order of 100 closed cars and 60 summer cars for the Minneapolis Electric Railway. They are also building 12 electric cars for Duluth, Minn.; 47 electric cars for Cincinnati and 13 electric cars for Findlay, O.; 14 electric cars are now being forwarded to Dallas, Tex. They are also building 3 cars for the Pneumatic Railroad, at Washington, D. C.

The Brownell and Wight Street Car Co. are building a number of street cars for electric railways at Louisville, Ky., Ft. Worth, Tex., and Duluth, Minn.; also 80 grip and 50 coaches for the new cable equipment of the St. Louis railroad—the Broadway line.

Mr. D. W. Guernsey, the St. Louis representative of the Edison electric railway system, has sold four 3 h. p. railway motors to the National Unicycle Elevated Railway Construction Co., for their motor cars.

B. J. Arnold, the St. Louis representative of the Thomson-Houston Electric Company, has closed contracts with the Missouri Car and Foundry Co. for 12 arc lights, with the East St. Louis Packing and Provision Company for 300 incandescent lights, direct current, and with the Osage Mining Company, McAllister, I. T., for a 20 h. p. motor which will be used for pumping in a coal mine, also, 1,300 incandescent lights for Desoto, Mo.

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Electrical Engineer.

VOL. X. DECEMBER 3, 1890. No. 135.

A PRACTICAL GUIDE TO THE TESTING OF INSULATED WIRES AND CABLES.—III.

BY HERBERT LAWS WEBB.

A VERY convenient form of galvanometer, illustrated in Fig. 9, is the tripod astatic. This galvanometer is much less expensive than the square pattern, and also more adapted for carrying about, as it can be packed in less space, making it a very useful instrument where much outside work has to be done. It has only two coils which are generally wound to a resistance of about 5,000 ohms. The mirror with the upper needles is suspended in the centre of the coils, and the lower needles with the vane hang just below the coils; the terminals, of which there are two only, instead of eight, are placed at the rear of the case. This form of galvanometer is not so sensitive, of course, as the

FIG. 9.—TRIPOD ASTATIC GALVANOMETER.

pattern first described, but if properly set up will give very good results, and is amply sufficient for all ordinary work, with the exception, perhaps, of testing very short lengths of heavily insulated cable. A little extra care is required in setting up the galvanometer, as it is not provided with a spirit level; if no small level is at hand to assist the eye, the best plan is to watch the mirror until it hangs exactly in the centre of the coils.

Another form of reflecting galvanometer, much used for outdoor work and carrying about from place to place, is the portable dead-beat instrument, illustrated in Fig. 10. The dead-beat arrangement was invented by Sir Wm.

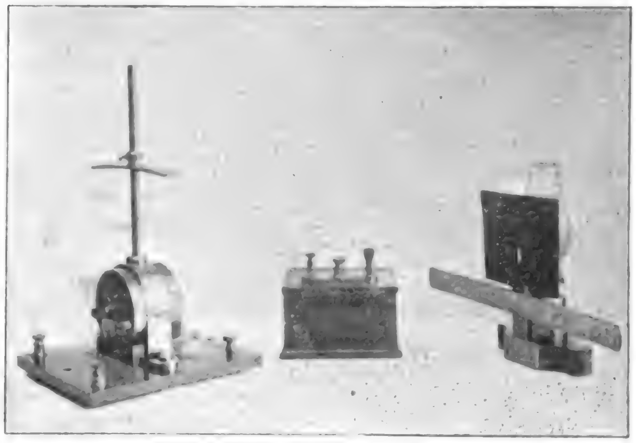


FIG. 10.—PORTABLE DEAD-BEAT REFLECTING GALVANOMETER SET.

Thomson, to do away with the inconvenience of waiting for the needle to cease oscillating before taking up a settled position on the scale. The mirror with the small needles at the back is suspended by a short fibre in a brass tube; the space in which the mirror hangs is transformed into a small air-tight chamber by two glasses, one set in the main part of the tube behind the mirror, and the other in a small cap which screws on in front. The air confined in this small chamber dampens the movements of the mirror, which, instead of oscillating back and forth for some time when current is turned on and off, turns steadily to a certain angle, or back to zero, and stops dead. The small galvanometer is shown with its lamp and scale and combined high resistance and shunt, forming part of a compact portable set of instruments for outdoor testing.

This form of galvanometer is by no means to be recommended for general work; it is not sensitive, and the readings, under certain conditions, are not any too accurate. Magnetic disturbances affect it very considerably, even if the moving iron be some distance removed from the galvanometer. To overcome this difficulty, which is present with a non-astatic instrument almost everywhere except in the open country, the magnetic shield, shown in Fig. 11, has been designed and has proved very useful. It consists simply of a hollow case of tin plate made in two sections so as to enclose the galvanometer coil, and filled up with iron filings. This arrangement forms a very efficient screen for magnetic disturbances under most circumstances, but in some cases it has failed to keep the needle from being affected.

SHUNTS.

THE most important accessory to a galvanometer is, of course, the shunt. This consists of a set of resistance coils placed in a suitable box or case provided with terminals by means of which it may be connected with the galva-

nometer and the source of current. The coils form a path outside the galvanometer for the current which will be divided between the shunt and the galvanometer coils in proportion to their resistances. The use of a shunt is very necessary with a delicate galvanometer because its sensitive-

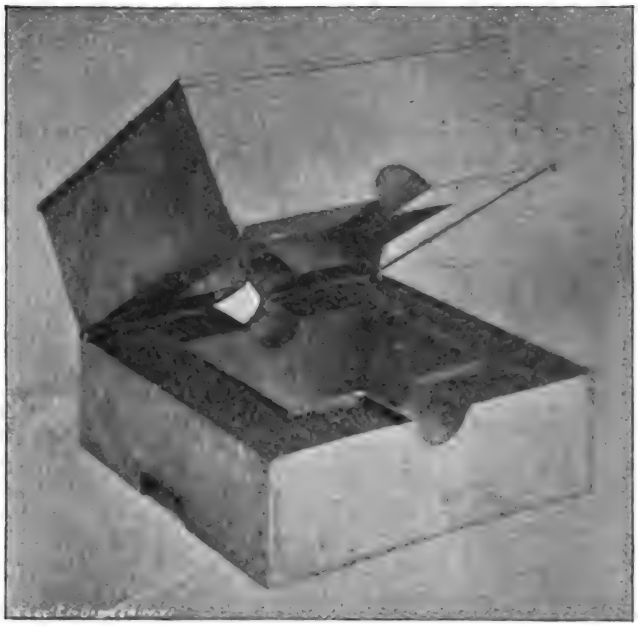


FIG. 11.—MAGNETIC SHIELD.

ness is so great that it will only measure directly very feeble currents; consequently when the deflection to be produced is likely to be beyond the range of the scale only a fixed proportion of the current is allowed to pass through the galvanometer, and the deflection obtained is multiplied by the value of the shunt.

The multiplying value of a shunt is equal to the sum of

FIG. 12.—SHUNT BOX.

the resistance of the galvanometer and that of the shunt divided by the resistance of the shunt, thus $\frac{G + S}{S}$.

For instance, if we have a galvanometer of 9,000 ohms resistance shunted by a coil of wire having a resistance of 1,000 ohms, substituting these figures for G and S we have, $\frac{9{,}000 + 1{,}000}{1{,}000} = 10$. The multiplying power of the shunt would therefore be 10, and all deflections obtained on the galvanometer with this shunt in circuit would have to be multiplied by ten in comparing them with deflections obtained without any shunt in circuit.

The shunt box generally contains three coils having, respectively $\frac{1}{9}$th; $\frac{1}{99}$th and $\frac{1}{999}$th the resistance of the galvanometer coils. The deflections obtained with the shunts must be multiplied by 10, 100 and 1,000, according to the coil used. Figs. 12 and 13 illustrate different forms of shunt boxes intended for use with Thomson galvanometers.

It is sometimes necessary or desirable to make up a shunt of some other multiplying value than ten, one hundred or one thousand, and this is an easy matter if a set of adjustable resistance coils is at hand and the resistance of the galvanometer is known. The resistance of a shunt having a multiplying value n is expressed as follows, $S = \frac{G}{n-1}$. Thus, if our galvanometer has a resistance of 8,000 ohms, and we wish to make a shunt having a multiplying value of five, the resistance to be given the

FIG. 13.—SHUNT BOX.

shunt would be $\frac{8{,}000}{5-1} = 2{,}000$ ohms. If we find the $\frac{1}{999}$th shunt does not reduce our deflections sufficiently, and we desire to make a shunt having the multiplying value of 5,000 instead of 1,000, then $\frac{8{,}000}{5{,}000-1} = 1.6$ ohms, or, to be more accurate, 1.6003 ohm would be the resistance of the shunt required.

The shunt should be placed close to the galvanometer so as to be as nearly as possible subject to the same temperature, and should be connected to it by short thick leads in order not to place any additional resistance between the shunt and the galvanometer.

ELECTRICITY AT RUTGERS COLLEGE.

Last commencement the trustees gave $2,500 for apparatus for the electrical engineering department, and this sum is being judiciously expended by the very competent professor in charge, Dr. F. C. Van Dyck. A much larger sum is needed, but the trustees cannot now see their way clear to give any more at present. A permanent fund should be raised for the department, it is claimed, so that it may meet all the demands that now come upon a new section of this character.

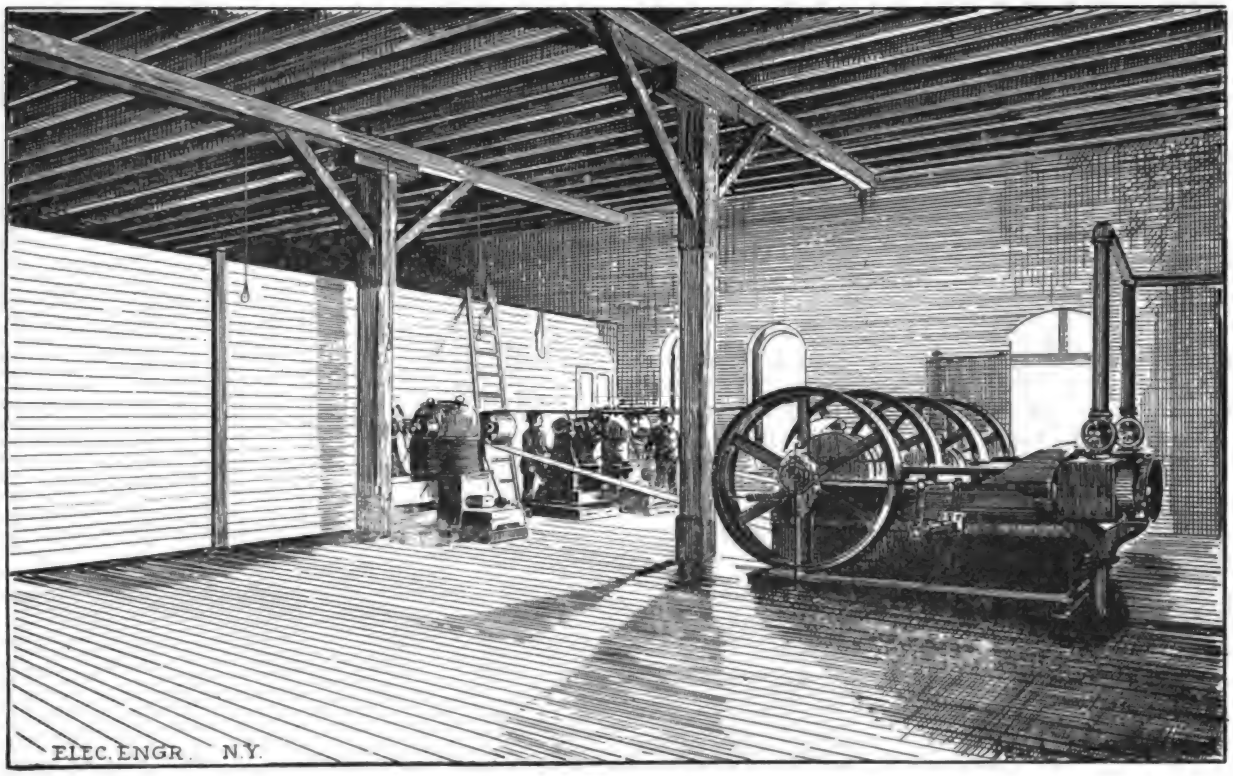


FIG. 1.—STREATOR, ILL., ELECTRIC RAILWAY POWER PLANT.

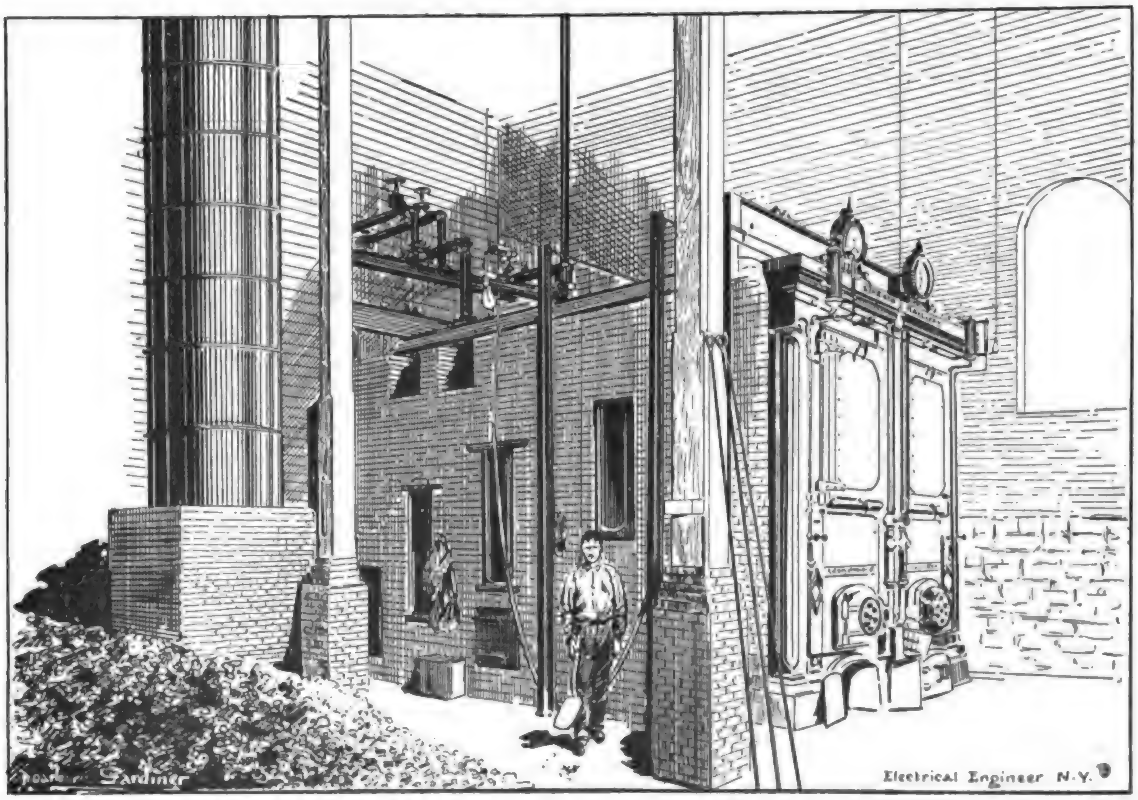


FIG. 2.—BOILER PLANT—STREATOR, ILL., ELECTRIC RAILWAY.

THE NEW ELECTRIC STREET RAILWAY AT STREATOR, ILL.

BY W. F. COLLINS.

HAVING recently had the pleasure of inspecting personally the plant, rolling stock, etc., of the new electric road of Streator, I am glad to furnish a few details and views of that interesting installation. The road is of the Thomson-Houston system, and is owned and operated by the Streator Railway Co., of which P. F. Barr is the president, D. Heenan, vice-president, W. Reeves, secretary, J. C. Barlow, treasurer, and W. Miller, manager.

The station, shown in Fig. 1, comprises two 125-h. p. Armington & Sims high-speed engines, belted direct to two 500 volt Thomson-Houston generators of 80-h. p. capacity each, compound wound and maintaining a constant difference of potential on the circuit irrespective of variations in the load. Two Babcock & Wilcox boilers, each of 125-

h. p., Fig. 2, provide the steam for running the engines. Two Buffalo steam pumps, manufactured by the Buffalo, N. Y., Steam Pump Company, and a Hoppes feed water heater, Fig. 3, of capacity sufficient for the two boilers, complete the steam equipment.

The whole power plant was furnished by the well-known Pond Engineering Co., of St. Louis, and erected under the personal supervision of Mr. Albert Blanchard, the Chicago manager of the company.

The electrical equipment was supplied by the Thomson-Houston Electric Co., and Mr. James H. Garrett, electrical engineer of the Northwestern Thomson-Houston Co., had charge of this part of the work and carried it out in the most praiseworthy manner. The road is at present operating six motor cars, but an increase in cars and an extension of the road will very shortly follow. The cars were built by the Laclede Car Company, of St. Louis, have 16 feet bodies and are elegantly finished. They are supported on Hubbard trucks, manufactured by the McGuire Manufacturing Company, of Chicago, and each car is fitted with two 15-h. p. Thomson-Houston motors. The power station is situated near the centre of the road which runs out on either side of it on North and South Illinois streets. From the station the main track runs up Main street and then branches out on each side on North and South Bloomington streets.

The whole road was built and equipped under the eye of Mr. Walker Miller, the manager of the company, and to the great care exercised by him and his intelligent supervision of everything in track, power house, electrical equipment, etc., to all the minor details of the work is due the great satisfaction and success which this new road has given and enjoyed. The franchise owned by the company also includes light and power, and it is probable that the station will shortly be extended to furnish this class of service in the very near future. The plant is likely, in fact, to present an interesting study as one combining all the various classes of electric light and power service, and as an example of the successful manner in which net revenues may be increased to the highest point by this method of operation.

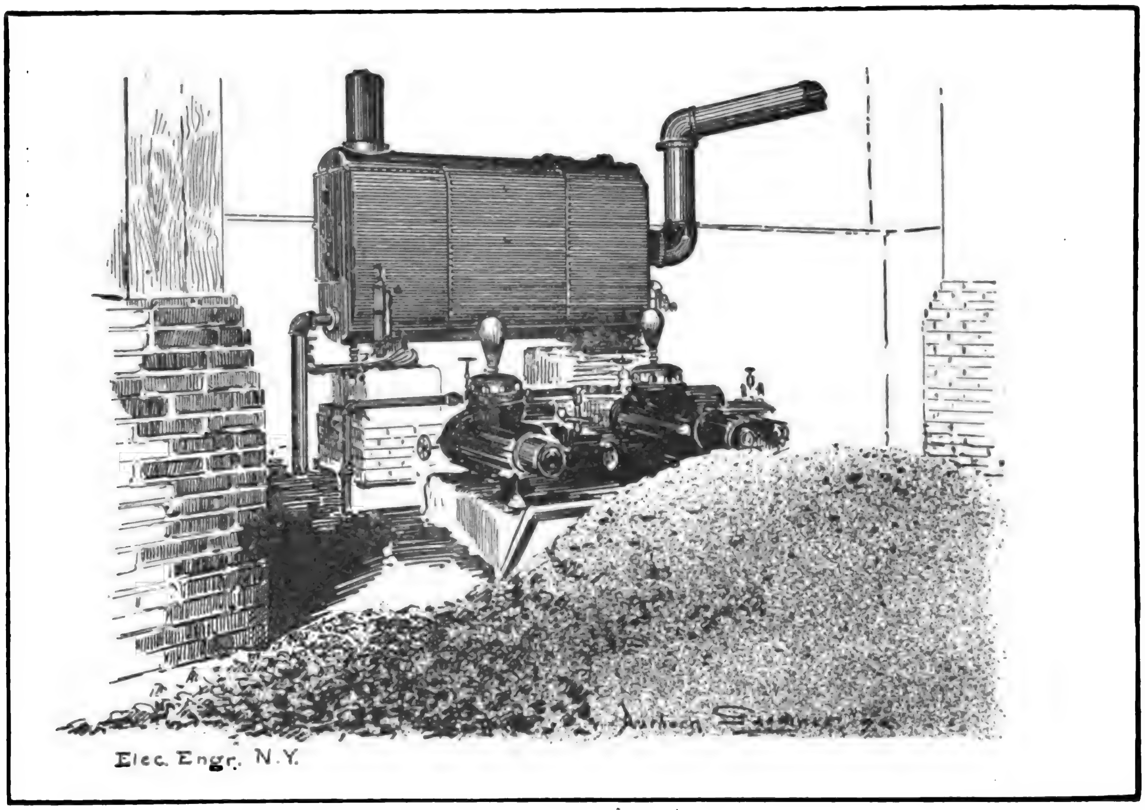


Fig. 3.—Hoppes Heater, Streator, Ill., Electric Railway Plant.

AN ELECTRICAL LOAD EQUALIZER.

BY C. O. MAILLOUX.

The task allotted to the steam engine in electric railway work is not an easy one. It would indeed be difficult to contrive a more crucial test than such work affords of the regulating qualities and mechanical endurance of an engine. The load is incessantly undergoing fluctuations which are not only sudden, but extremely severe. An interval of a few seconds often marks the jump from light load to the maximum capacity of the engine, or else a sudden release from full load to no load. Yet, under these trying conditions the engine is required by the electrical engineer to satisfy in turn and collectively the three important requirements of close regulation, great mechanical endurance and high economy. It is almost needless to say that these three qualities have not yet been reconciled under such conditions. In electric railway practice, it is not uncommon to find a 100 h. p. engine carrying an average load of from 40 to 60 h. p. The fact that the load is likely to jump up now and then to 100 or 120 h. p. makes this margin necessary, for without it, the first two qualities, regulation and endurance, could not be secured. As for the third quality, it is of necessity sacrificed. Even under this compromise the durability, as experience shows, is not by any means an assured quality. Practice is indeed drifting to the conclusion that a further compromise must be made to favor still more the second at the expense of the first quality, and engines of slow-speed types are coming into use. This change also favors the third quality incidentally, but only to a remote degree.

The question of economy in electric railway working is not altogether one of engine type or capacity for the

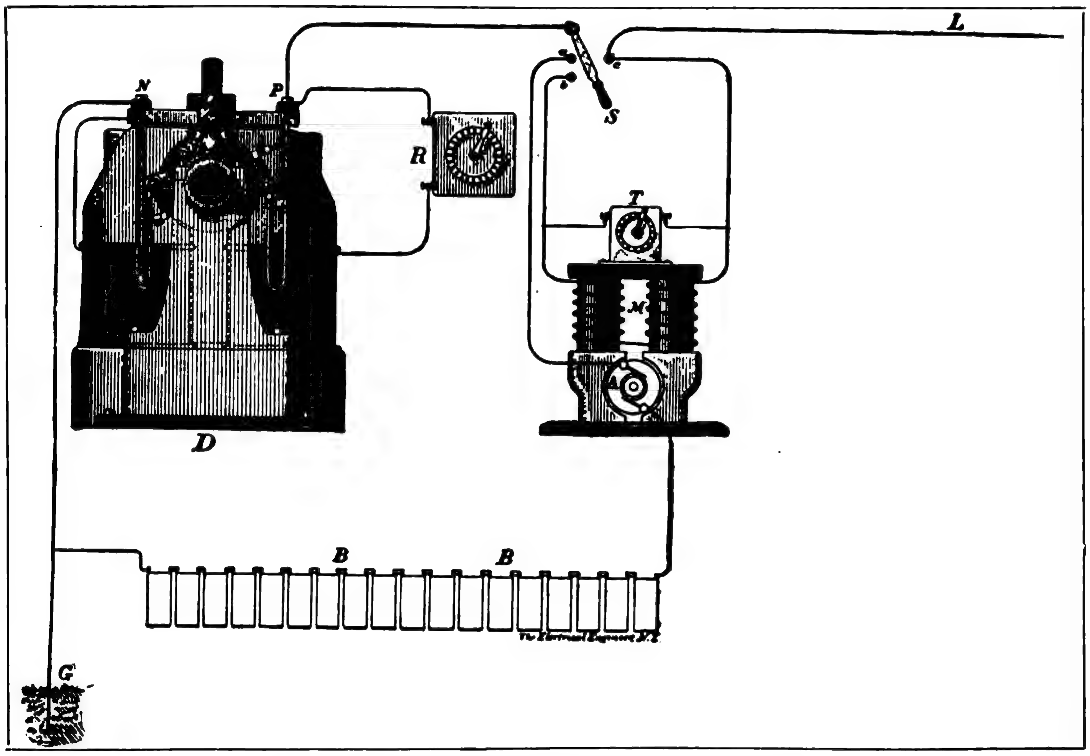
particular case. The efficiency of an engine running light is zero; that of an engine overloaded and taking steam during the entire stroke is also very low. Between these two extremes there is a point of maximum efficiency, corresponding usually to the nominal rated capacity of the engine. If the engine can be worked at this capacity, and if fluctuations much above or below this load can be avoided, the conditions will no longer be incompatible with, but will become favorable to, efficiency. With a steadier, more uniform load, the problem of speed regulation of course vanishes, while that of durability becomes greatly simplified.

It was this reasoning which led the writer some time ago to devise a method of equalizing the engine-load by electrical means, and of rendering the engine independent, to a great extent, of the fluctuations in power consumption on the trolley lines. The method aims to accomplish electrically for the dynamo what the fly-wheel does in a mechanical way for the engine. It provides the circuit with a kind of reserve fund of energy that is ready to instantly appropriate any surplus of electric power when the load is light, or make up the deficit when it is heavy.

an electric motor supplied from the trolley circuit. This armature is made of low resistance and capable of carrying a large current.

The cells B B may be of any form, although the Planté type is preferable on account of its simplicity and its ability to withstand severe rates of charge and discharge without injury. These cells need be but of small capacity or only partially formed, since the storing capacity required of them is very small, as will be seen. The number of cells required will depend on the voltage of the circuit. For a 500 volt circuit, which is the usual standard in electric railway practice, a series of about 225 cells would be required. The facilities for adjustment are such, however, that the number of cells may be varied considerably without detriment. It will be seen from the connections that so long as no current is consumed on the line the armature A will have its field demagnetized. It therefore generates practically no E. M. F. and constitutes merely a dead resistance.

By the passage of current to the trolley line the field magnet coil M is excited and made to produce a definite



Mailloux's Railway Power Equalizing System.

The method consists in connecting to the terminals of, and in parallel with, the ordinary generating dynamo D supplying feeder circuit or trolley line L, a compensating circuit, including a series of storage-battery cells B B, and the armature A of a small supplemental generator. The field magnet coil M of this small generator consists of a few turns of large wire similar to the series coil of a compound-wound machine. This coil is not included with the armature in the compensating or branch circuit, but is placed in the circuit leading to the trolley line. Consequently when the circuit switch S is thrown to the left, thereby connecting the dynamo to both points *a* and *b* and closing both the main and branch circuits, the current sent out to the trolley line L will pass through the coils M, suitable means, such as a shunting rheostat T, being provided, whereby the effectual ampere-turns due to a given current may be adjusted.

The armature A of the small machine is driven at constant speed by power obtained from any convenient source, as, for instance, the same engine that drives the main dynamo D. It might be driven by a separate engine or by

amount of field magnetism. It is evident, therefore, that the E. M. F. of the armature A will depend altogether on, and will rise or fall directly with, the current consumed on the trolley lines. This E. M. F. is so "poled" as to add itself to that of the cells B B. It results that when there is no power consumed on the trolley line the voltage of the cells B B will be so much lower than that of the dynamo D, that there will be a large "overflow" of charging current into them. As the power consumed on the line L is increased, the armature A will begin to generate an E. M. F. that will raise the effective voltage of the battery and consequently reduce the charging current, until finally at a certain point, it will stop altogether. If the current now rises above this limit, it will raise the effective voltage of the compensating circuit above that of the dynamo. Consequently the battery will now begin to discharge current into the circuit just as if it were another dynamo coupled in parallel with the main dynamo D. When this point is reached if the field magnet of the small machine is still much below saturation, the further increase of the current may raise the effective E. M. F. of the compensating circuit con-

siderably higher than that of the dynamo. It might seem, therefore, that the dynamo D is likely to be overbalanced and converted into a motor.

There is another important factor that intervenes here, however, viz., the polarization of the battery. It is well known, as one of the disadvantages of storage batteries, that their potential difference is diminished as the discharge current is increased, partly owing to their internal resistance and partly to the effect of polarization, the latter being especially marked with heavy discharges. It follows from this that the effectual voltage of the compensating circuit when the discharge begins, will not rise in proportion to the E. M. F. added by the armature A, but at a rate which is slower the greater the current; consequently, when a certain current value is reached the rise in effective voltage will be much slower. If this does not suffice to limit the rise of E. M. F. made in the compensating circuit, the adjustments can be made to lower the saturation point of the field cores, so that the bend of the characteristic may correspond to a lower current. This can be done by suitably proportioning the iron in the field magnet cores; or, with a given machine, by varying the effectual ampere-turns, by means of the shunting rheostat T, the speed being changed so as to preserve the same total range of supplemental E. M. F. Thus it is seen that the rise of effective E. M. F. in the compensating circuit can be limited at any desired point.

If the limit is the same as the E. M. F. of the main dynamo, then the compensating circuit will supply about half the current required for the trolley line. If the limit is a trifle higher the compensating circuit will supply slightly more than half. If the limit be sufficiently high the compensating circuit will assume practically the whole load, and relieve the dynamo and engine.

It is not necessary, as might appear at first, that the field cores of the supplemental generator should be laminated, to make the apparatus sensitive and responsive to sudden fluctuations. Advantage, again, is taken here of the polarization of the batteries. It requires a minute interval of time for a storage battery to polarize or depolarize. This interval will practically balance the time required for the rise or fall of magnetization.

As a case illustrating the operation of the above method let us take a dynamo of, say, 50,000 watts capacity, supplying a railway circuit at 500 volts pressure. Under present practice the average load put on such a machine would scarcely exceed 60 amperes, and the engine would be of about 100 h. p. capacity, if not more. Instead of this, an engine of about 80 h. p. would be used, and the average load would be made at least 90 amperes. The compensating circuit would then be so adjusted that whenever the current consumed on the trolley line would fall much below 90 amperes the main dynamo would overflow into the battery. If the consumption ceased altogether, for a brief instant, as so often occurs, the dynamo and engine, instead of running empty, would run at nearly the same output, the whole current being sent into the batteries.

As the current increased on the trolley line the overflow would diminish, and, at a little below 90 amperes, it would cease. Any increase above 90 amperes would cause the battery to discharge and help the dynamo. The greater and the more urgent the demand for assistance the more promptly and liberally will the supply be given. Not only will the supply provide for the excess of current required above the 90 amperes furnished by the dynamo, but, as shown above, it may be made to relieve the dynamo itself either partly or wholly.

Let us now analyze the action of the compensating circuit. When there is no current on the trolley circuit the current sent into the batteries will pass through the armature A as if it were a dead resistance. When current is consumed on the line, however, the magnetic field becomes excited, and the charging current now operates the armature A as a motor. The amount of energy thus re-converted is not large, however, since the charging current is large only when the counter E. M. F., generated by armature A, is small, and vice versa. When the working current rises above the adjusted limit of 90 amperes the batteries begin to discharge, and the armature A then becomes a dynamo.

Let us assume that the load jumps up suddenly to double its average value, or 180 amperes, and remains so for five minutes. Such severe fluctuations are not infrequent, although they scarcely persist, as a rule, longer than from a few seconds to a minute. Let us assume that the compensating circuit will carry the excess of 90 amperes, making, at, say, 501 volts, an output of 45,090 watts. If we assume that the battery will so polarize at this rate of discharge that it cannot be counted upon for more than, say, 1.8 volts per cell, we have, as the available potential difference of the battery, $225 \times 1.8 = 405$ volts. The armature of the supplemental generator will therefore need to supply $501 - 405 = 96$ volts. The amount of energy which the supplemental dynamo must provide will consequently be $96 \times 90 = 8,640$ watts. The battery supplies the rest, or $405 \times 90 = 36,450$ watts.

If the same engine drives both dynamos, we see that a rise of 100 per cent. in the current load will only cause a rise of 20 per cent. in the output of the engine. The battery furnishes the other 80 per cent. If, however, we consider that the engine is likely to slacken its speed slightly when the fluctuation occurs, or if we adjust the supplemental dynamo to a slightly higher limit of E. M. F. the main dynamo D will be partly relieved of its own load.

In other words, the conditions can be made such, that the main dynamo will carry, let us say, only 80 amperes, and the compensating circuit 100 amperes. The combined load of both dynamos will now be $80 \times 500 = 40,000$, and $100 \times 96 = 9,600$; total, $40,000 + 9,600 = 49,600$ watts, or only 4,600 watts, or 10 per cent. more than the average working rate of the main dynamo. The battery will supply $100 \times 405 = 40,500$ watts or 90 per cent. of the energy required in excess of the average load.

The storage capacity required to compass such a severe and prolonged fluctuation is naturally a question of importance. A current of 100 amperes for five minutes represents a total of 500 ampere-minutes or $\frac{500}{60} = 8.33$ ampere-hours. Hence, if each cell has a storing capacity of only 10 ampere-hours it will have margin sufficient for all contingencies. Even if doubled, the capacity per cell would still be only about one-eighth to one-tenth of the capacity of the cells used in storage battery traction. For a 50,000 watt dynamo the series of cells required would be equivalent in storage capacity to about one-fourth of the battery usually put into each storage battery car.

With the above method of equalizing the load, the part assigned to the engine becomes wonderfully easy and simple. The engine no longer is required to anticipate and provide for jumps in the load. It no longer has the responsibility of keeping the current pressure steady, or its supply adequate. Its load becomes so nearly uniform that the first of the three requirements noted in the beginning, close regulation, is no longer of primary but is of remote importance, while the second and third are at the same time greatly facilitated. The slow-speed, double-valve engine, whose superior economy is conceded, now becomes not only permissible, but eminently practicable. We must also bear in mind that this method further favors economy by materially increasing the working capacity of a given plant, obviating, as it does, the necessity for the margin required under the old way, to compass the fluctuations of load. The method is, it is evident, applicable to all systems of the constant potential description, and is adaptable to circuits fed either direct or by feeders. The method can be applied to any existing plant without difficulty.

On following the connections in the diagram it will be seen that by turning the switch s to the right, instead of to the left, the compensating circuit is entirely disconnected and the plant operates in the usual way, leaving the engine to bear the brunt of any fluctuations in the power consumed. The method admits of being modified and applied in an indefinite variety of ways which cannot be detailed in this space.

In conclusion it may be noted that accumulators have been for several years used as equalizers or regulators in connection with incandescent lighting circuits. The compensating action thus obtained, however, is much limited in scope and degree. The battery, when unaided, evidently cannot begin to assist the dynamo until the latter has actually wavered perceptibly in potential; and anything like a severe rate of discharge would at once lower the potential below that of the dynamo itself. Hence, even though, in such cases, large cells are used, to reduce the internal resistance and polarization to a minimum, the compensating action is useful only for compassing relatively minute and brief fluctuations. By supplementing the E. M. F. of the accumulators, as is done in the method of the writer, the action is rendered independent of the size of battery used or of the extent and degree of the fluctuations to be compassed. Not only this, but the action does not depend on the loss of E. M. F. of the main dynamo. In fact, as we have seen, the method has for one of its objects to obviate any fall of voltage at the dynamo terminals, while it will easily, if desired, produce the contrary effect, or raise the voltage as the load increases, the same as is done by an "over-compounded" dynamo.

THE HARDING CONDUIT RAILWAY SYSTEM.[1]

BY C. K. HARDING.

The increased interest shown in electric propulsion at the recent convention of the American Street Railway Association, may serve as an excuse for bringing to your notice an improved conduit system, which, although new, is, I think, destined to play an important part in the solution of the problems met in the practical application of electricity, to urban passenger transportation.

My invention embraces as its principal features, a continuous main or supply conductor, insulated and protected in the tubular lower part of a casing, a cross section of which is shown in Fig. 2; and a series of working conductor sections, insulated and supported in the top channel of the casing, with their upper surface exposed and adapted to come in contact with brushes on the car—and electromagnetic contact-making devices, for bringing the conductor sections separately and successively into electric connection with the main insulated supply conductor. These contacts are arranged to be operated by a very small current, derived from the main conductor and extending through branch wires to the adjacent sections, thence through the forward brush to a rheostat on a car, and thence to ground or a return conductor. Fig. 1 shows a working plan of the apparatus; the car itself is supplied with two brushes, at a distance apart, equal to the length of a section of the working conductor, which is laid centrally between the tracks.

The ends of the section are separated by insulating material, and the contact length of each collector is sufficient to overlap this insulation and momentarily receive current from two adjacent sections. As a matter of fact these collectors are intended each to consist of a pair of small wheels running on the supply rail.

Closed at the start, a single one of the switches throws current into one of the sections on which the car rests, and thereafter, whether the car is moving or at rest, the operation of the parts is entirely automatic. Fig. 1 shows three sections of the track and three of the automatic switches. It will be seen that the switch consists of an electro magnet, furnished with an armature which serves to lead the current to a projection from the working conductor.

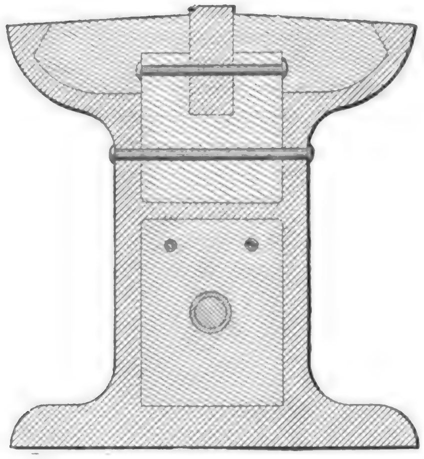


FIG. 2.—THE HARDING ELECTRIC RAILWAY CONDUIT.

The opposite end is turned upward at right angles, and forms another switch the purpose of which will be seen later. The terminals of each magnet are connected, respectively, to the preceding and succeeding sections of the working conductor, to the former through the contact devices shown, and directly to the latter.

Suppose now the switch of the left hand section shown open, to be closed, and the rear collector of the car to be just leaving the section, while the forward collector is just passing from the central to the right hand section shown. Current now passes into the first section of the working conductor through the closed switch, and also through the double contacts connected together by the rear end of the magnet armature through the small connecting wire, to and through the magnet of the middle section, and thence to the car, through the forward part of the forward brush. Thus the magnet of the central section will be energized and its armature attracted closing the switch and letting the current pass from the supply conductor to the central section of the working conductor; but as soon as this switch is closed, the magnet of the first section is shunted around by the low resistance of the direct connection between the supply conductor and the central section of the working conductor.

Hence its armature falls, and in falling breaks all con-

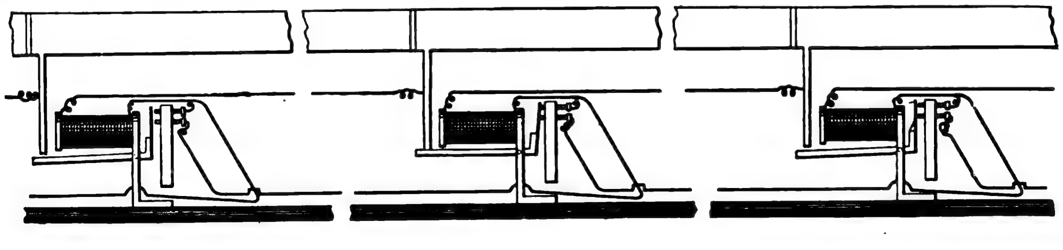


FIG. 1.—THE HARDING ELECTRIC RAILWAY CONDUIT.

1. Abstract from *Street Railway Gazette.*

nection with the first section and leaves it insulated. As the car passes on, this operation is successively repeated through the following sections.

The result of this arrangement is a continuous supply to the sections immediately under the car, the remainder of the working conductor being insulated; consequently there is but little tendency to leakage, and the insulation, usually so difficult, becomes comparatively simple. It will be readily understood, that neither moisture nor a conductor accidentally coming in contact with a section of the working conductor, and grounding it, would cause a short circuit, nor maintain one, after the car had passed; and this is an essential feature.

The simplest form of electro-magnetic contact device would be one, in which the magnets would be in series with the motor; but this would require magnets of a large size, wound with a coarse wire and would require a large amount of current to maintain the contact when the car was stopped, and would be liable to sparking and sticking at the contacts. By the arrangement of the magnets in multiple arc, I am enabled to use small magnets wound with fine wire, and to put the whole contact device in a junction box, Fig. 3, about 3x3x4 in., formed by an enlargement of the lower tube. The whole conduit may be made complete in sections 4 to 6 feet long, and coupled together and put into position in centre of the tracks, without disturbing the track rails already down; the conduit being only about 7 inches high.

It will be seen that the conduit is entirely closed, the main wires imbedded in insulating material in the lower part, and the conductor sections in the upper flaring portion.

The forward part of the car of my system is supplied with a small revolving brush, which sweeps the top of the conduit, and keeps the conductor sections clean.

The safety of this system cannot be questioned, as the only sections that can carry current are those immediately under the car, and protected by it. The path for the return current is through the iron casing and the track rails, thus forming a parallel return, which acts the same as a double trolley system in avoiding inductive interference with telephones.

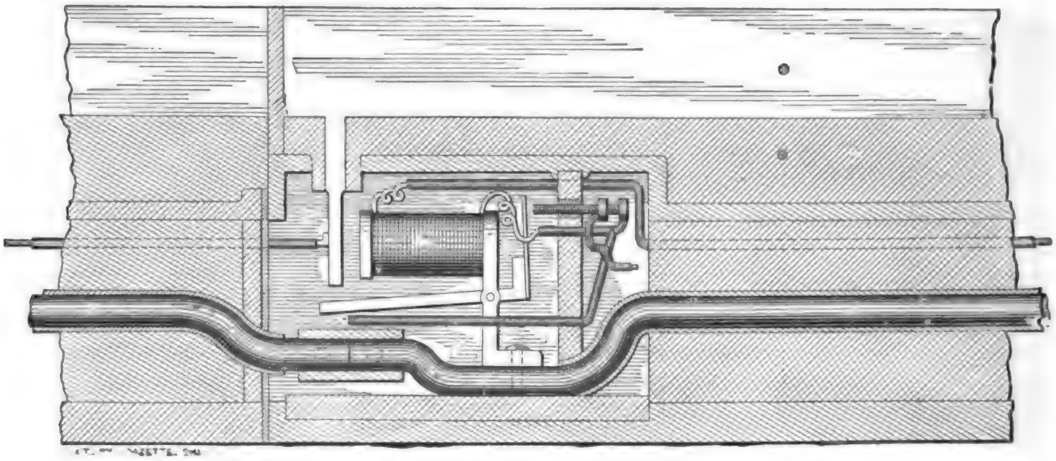


Fig. 3.—The Harding Electric Railway Conduit.

INDIAN SONGS IN THE PHONOGRAPH.

Prof. J. Walter Fewkes says that a phonetic means of studying the language of the Indians and some means of making a record of what is said with accuracy is much desired. The phonograph is such a means, not, perhaps, wholly perfect as yet, but still it serves the purpose. Indian songs, prayers, ceremonials, rituals and speeches by this wonderful instrument are recorded. With the encroachments of whites it is quite certain that in a short time these would be lost were it not for the phonograph. Prof. Fewkes illustrated at the fall meeting of the National Academy of Arts and Sciences the preservation of the songs, etc., of various Indian tribes.

VIBRATIONS OF AN INCANDESCENT PLATINUM WIRE WHEN TRAVERSED BY AN INTERMITTENT CURRENT.

In a recent number of the *Comptes Rendus* M. Argyropoulos describes the following experiment: Take a platinum wire about .7m. long and a fraction of a millimetre in diameter, and pass a current through it until it becomes incandescent; then, if the wire is stretched in a horizontal position and Foucault interrupter is inserted in its circuit, the wire immediately vibrates and becomes subdivided into a series of waves having well-marked ventral segments and nodes. The number of segments is augmented by very slowly decreasing the tension of the wire. On increasing the tension the number is diminished until the incandescent wire vibrates transversely with a single ventral segment at the middle. M. Argyropoulos employed a battery of from 45 to 50 Bunsen cells, and screwed down the commutator until the wire became white hot; then, if the commutator was released, the stretched wire immediately commenced to vibrate.

SILVER REFINING BY ELECTRICITY.[1]

The method is most suitable for the refining of auriferous silver containing about 11 per cent. of gold, the cost in this case being only about 14 cents per pound. The principle upon which the process is based consists in using in an ordinary electrolytic bath anodes of an argentiferous matte, and a thin plate of pure silver as the cathode. The bath consists of a very weak solution of nitric acid containing about one per cent. of the acid. The anodes, which are about one-half inch thick, with a surface of about 13.5 square inches, are placed in muslin bags, which retain the gold, platinum, peroxide of lead, and similar foreign materials contained in the matte. The current used is 150 amperes, and the potential difference between the plates one volt. During the whole period of work brushes are kept moving up and down the silver plates, sweeping off the silver deposited into troughs put for the purpose at the bottom of the bath. These troughs are removed from time to time, and the silver taken out and sent to the furnace. If the matte contains copper, this is dissolved by the nitric acid, but is not deposited on the cathode.

WHEATSTONE BRIDGE MEASUREMENTS WITH TELEPHONE.

Some useful suggestions with regard to the measurement of resistance have recently been made by M. Chaperon, who, in three short papers, discusses the capabilities of the Wheatstone's bridge method when a telephone and alter-

1. *Engineering and Mining Journal.*

nate currents are used in place of the ordinary galvanometer and battery. In spite of the great delicacy of the telephone, measurements made with it are much less accurate than those obtained with a reflecting galvanometer, because the adjustment for minimum sound is never sharply defined.

The ordinary method of double-winding used in resistance coils serves very well for most direct current measurements; but the compensation for induction effects is not nearly perfect enough when rapidly alternating-currents are used, and, according to M. Chaperon, the results obtained under such circumstances are exasperating. The new coils have been wound singly, but so that successive layers are wound in opposite directions, the operation being effected by a specially constructed machine. The current in adjacent conductors thus flows in opposite directions, and self-induction is practically eliminated, while the capacity effect is rendered negligible since contiguous portions of the wire are at nearly the same potential.

JONES' SAFETY DEVICE FOR OVERHEAD CONDUCTORS.

Experience has shown that too many precautions cannot be taken to secure immunity from accident due to broken wires carrying high tension currents, and it is only by constant attention to this important point that the public can be disabused of the idea that the distribution of electricity

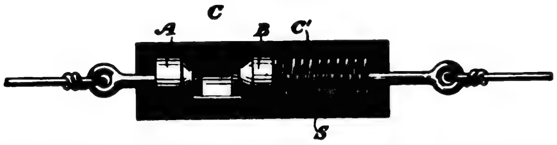


Fig. 1.—Jones' Safety Device For Overhead Wires.

is attended with danger. Among the recent plans devised to secure such safety we desire to call the attention of our readers to a simple safety device, due to Mr. Frank W. Jones, the well-known assistant general manager of the Postal Telegraph Cable Co., of this city.

Although equally well adapted to all high tension circuits, Mr. Jones has sought more particularly to afford a simple way of protecting electric railway conductors, and for this purpose has embodied a method by which a movement of the wire of but an inch from its normal position will cause it to be rendered harmless; thus, should a wire be broken it will have been rendered innocuous before its ends will have touched the ground. This has been carried out in the device shown in the accompanying illustrations, Figs. 1 and 2, and the manner in which they are applied is shown in Fig. 3, in connection with the trolley wire and main conductor of an electric railway.

The safety device, as will be seen, consists of a hard rubber case enclosing two contacts A and B, Fig. 1. This

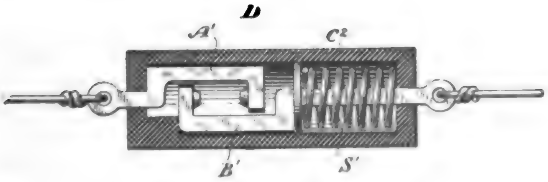


Fig. 2.—Jones' Safety Device For Overhead Wires.

device is shown attached at C with one end connected to the main conductor G W, Fig. 3; the other end is connected to earth. When the conductor is in its normal position, the tension produced by the wire on the spring maintains the contacts A and B apart. Any breakage of the wire G W, however, or any abnormal slacking, causes the spring S to bring the contacts A and B together and thus grounds the conductor. This, of course, is at once noticed at the station where safety devices, such as cut-outs, are applied to prevent destruction of the machine. When the trouble is located and the wires are rejoined, the earth contact is, of course, removed, and the conductor again placed in working condition.

Another form of the device is shown in connection with the trolley wire T W. Here, instead of being placed below, the safety device D is placed above the wire and, as will be seen in Fig. 2, the tension of the branch wire attached to the trolley wire is counteracted by the spring S' so as normally to keep the contacts apart; but upon the breaking of

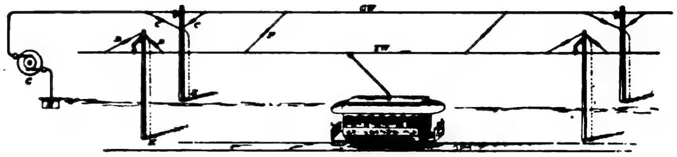


Fig. 3.—Jones' Safety Device For Overhead Wires.

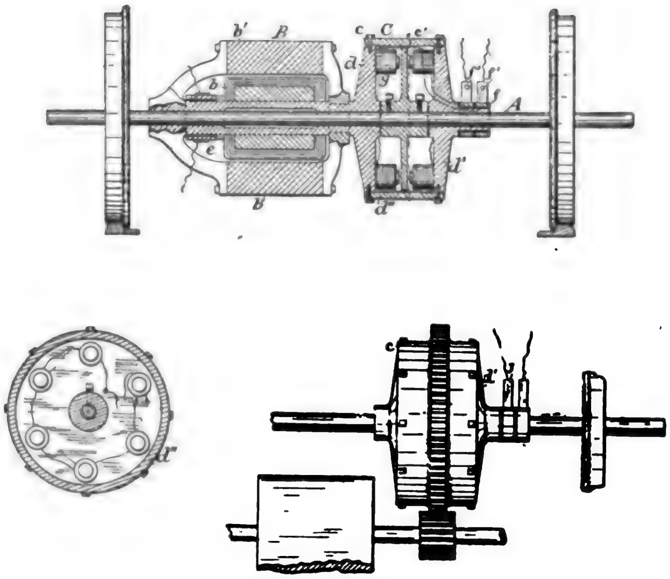
the trolley wire, the spring brings the contacts together and connects the trolley wire directly to earth, thus rendering its ends harmless.

Practical tests with Mr. Jones' device have shown it to answer admirably the purpose for which it is intended, and would seem to make it well worth the attention of electric railway companies.

DEWEY'S ELECTRO-DYNAMIC CAR GEAR.

The reduction in the number of gears necessary to transmit the motion of the motor armature to the car axle has been the aim of many inventors, and has resulted in various forms of mechanical and hydraulic devices. We desire to call the attention of our readers to another method in which this problem has been solved by Mr. Mark W. Dewey, of Syracuse, and which may be termed an electro-dynamic one.

The gear which is shown in the accompanying engravings has the motor mounted loosely on the axle, thus dispensing



Figs. 1, 2 and 3.—Dewey's Electro-Dynamic Car Gear.

with all gear wheels. Upon one side of the armature shaft opposite the end carrying the commutator *e*, is fixed a part of the electric speed transmitting and reducing mechanism C, which is also sleeved loosely on the axle.

The mechanism *c* fixed to the armature shaft consists of two discs *d d'*, facing each other and coupled together at their peripheries by a ring *d''*, encircling them, and bolted to each. Upon the inner faces of each of the discs *d* and *d'* and near their peripheries are fixed a series of electro-magnets *g* and *g'*, with the poles of one series facing the poles of the other series, but a distance apart. The

coils of the magnets are wound so that north poles will face south poles. In order to conduct the current to the magnets, a two-ring commutator *f* is provided, which is insulated from an extension of the hub of the outer discs *d'*, and shown in Fig. 1 in section and in Fig. 3 in elevation.

Between the poles of the magnets *g* and *g'* is arranged a circular plate or disc *c'* of copper, and it forms a part of a hub which is keyed to the axle. This disc and its connection constitute the second part of the power transmitting and reducing mechanism.

It is well known that if a copper disc is rotated near a magnetic needle that the needle will rotate with the disc, but at a slower speed than the disc. This is due to the induction of currents in the copper by the movement of the needle, these currents being such as to oppose that motion of the needle which is the origin of the induction. Mr. Dewey's speed transmitting and reducing mechanism acts on the same principle. The operation of the mechanism is as follows: The armature of the motor rotates the part of the mechanism carrying the electro-magnets at the same speed as the armature, and the disc forming the conductor of the induced currents is both attracted and repelled vigorously in the same direction as the movement of the magnets, but at a reduced speed, depending upon the speed of the magnets and the strength of their magnetism.

It will be noticed that one of the parts of the transmitting mechanism is directly connected to the armature. This is done, if the armature is not sleeved upon the axle or supported by the same, by providing the periphery of the cylinder with cogs as shown in Fig. 3, to work directly in mesh with a pinion on the armature-shaft.

WRIGLEY'S VERTICALLY-ADJUSTABLE DYNAMO SUPPORT.

ONE well marked change which has been brought about by the experience gained in the operation of electric light and power stations and which is manifesting itself strongly in the more modern ones, is in the relative position of the dynamos and engines. While formerly both were placed on the same floor level, economy of operation, as well as convenience in handling, has dictated the placing of the engines on solid foundations, with the dynamos on the floor above. This, of course, necessitates the running of belts vertically to connect the engine pulley with that of the dynamo. As in the horizontal arrangement, means must here also be afforded for maintaining the proper tension of the belt and, on the other hand, for releasing it when the dynamo is not in operation so as to retain the elasticity of the belt. This requires a vertical adjustment

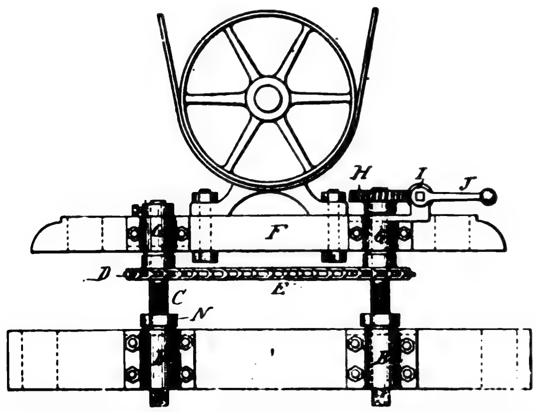


FIG. 1.—WRIGLEY'S VERTICALLY-ADJUSTABLE DYNAMO-SUPPORT.

of the dynamo support, and to effect this in a simple manner Mr. Thomas Wrigley, of Chicago, Ill., has recently designed and patented the dynamo support which is illustrated in the accompanying engravings, Figs. 1, 2 and 3.

As will be seen, the frame A has attached to it the boxes B, which constitute stationary nuts for the jack-screws C. Each of these screws has a sprocket wheel D mounted on it over which passes continuously the sprocket chain E.

The upper ends of the screws C are pivoted in the boxes G attached to the frame F which supports the dynamo. One of the jackscrews, it will be noted, carries a worm wheel H which can be driven by the worm and

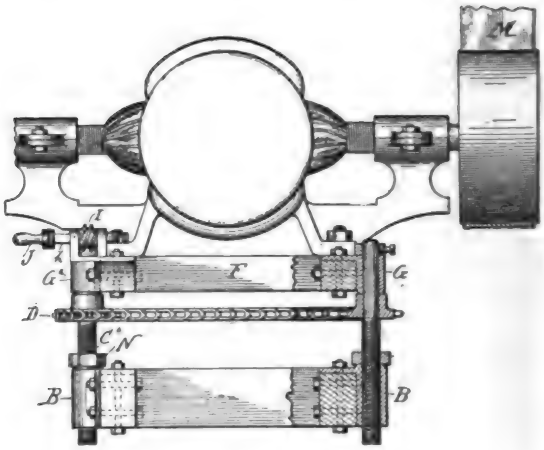


FIG. 2.—WRIGLEY'S VERTICALLY-ADJUSTABLE DYNAMO SUPPORT.

crank, and which turns all the screws simultaneously through the medium of the sprocket chain.

The effect of this is that by turning the crank the machine is raised or lowered uniformly and horizontal to the desired degree so as to bring the belt to full tension,

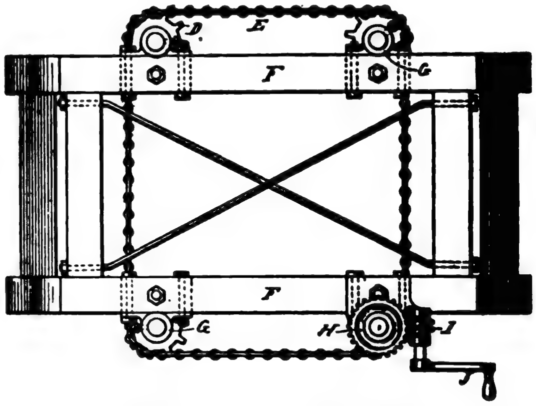


FIG. 3.—WRIGLEY'S VERTICALLY-ADJUSTABLE DYNAMO SUPPORT.

or to release it. When the machine has been raised so as to tighten the belt, the jam nuts N on the jackscrews are screwed up, so that no slacking can take place.

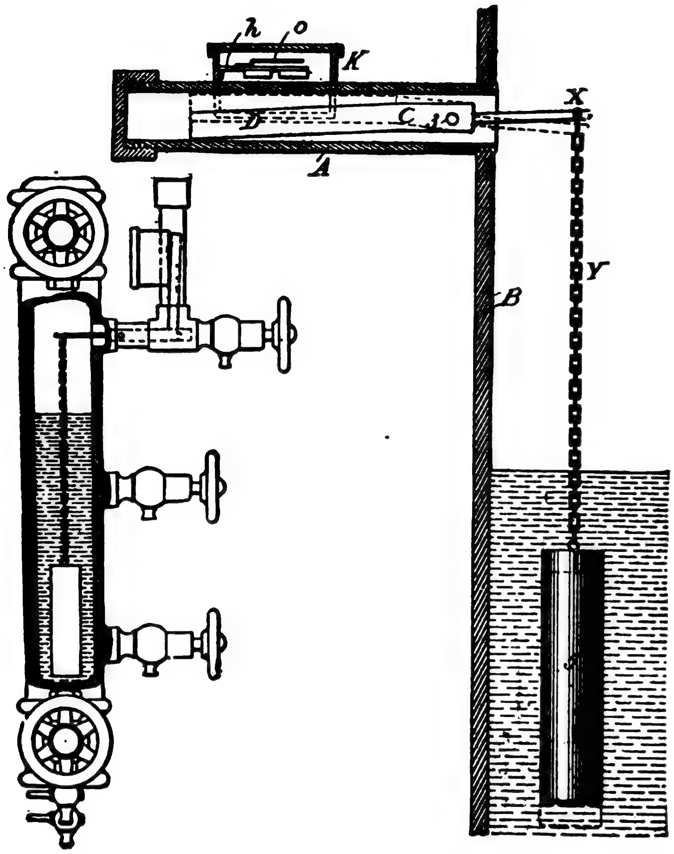
PROMISES OF CHEAPER ALUMINUM.

For some time the Cowles Electric Smelting and Aluminum Company, of Lockport, has been preparing to produce aluminum by a new process, which is claimed to be a successful solution of the problem of the cheap extraction of this metal from common clay. Eugene H. Cowles, president of the aluminum company, says: "We now expect to offer a pure metal made by a new process that is radically different from anything yet known to metallurgists—a process that is ridiculously simple in operation and almost theoretically perfect. By reason of two chemical discoveries it is found that the pure metal can be extracted direct from the clay. This can be done without the use of electrical heat. When operated on as large a scale as that on which iron is produced aluminum will be produced at a cost permitting it to sell at $200 per ton, a price less than the present price of copper. Alterations will be made immediately in our works here to make the metal on a large scale. Capitalists in New York are preparing to build immense new works of probably twenty times the capacity of the Lockport works. One of the large plants will undoubtedly be at Niagara Falls, where 10,000 to 12,000 h. p. will be required to operate it.

"As soon as the plant at Niagara Falls is in operation—say by July, 1892—the world can expect a supply of aluminum at least 99 per cent. fine, at prices not to exceed 50 cents per pound."

GHEGAN'S MAGNETO-ELECTRIC LOW WATER ALARM.

WHILE no apparatus can be expected to make entirely unnecessary the presence of an attendant for a steam boiler, a number of useful safety appliances can be employed to advantage. Among these, an audible, low-water alarm, especially when connected with the office of the superintendent, will go far towards securing immunity from accidents, and, at the same time, economy in operation.



FIGS. 1 AND 4.—GHEGAN'S MAGNETO-ELECTRIC WATER ALARM.

With this object in view, Mr. J. J. Ghegan, of Newark, N. J., some time ago brought out a simple device which has lately been considerably improved, so that it meets completely the conditions imposed.

The mechanical principle involved in this apparatus depends for its action on the simple fact that a body, when surrounded by a liquid, weighs so much less by the quantity of liquid displaced.

This principle is applied in making a normally submerged float actuate a circuit-closing device of novel construction. The accompanying engraving, Fig. 1, illustrates the mechanical arrangement and one method of attaching the alarm to a steam boiler. It consists of a short brass pipe, A, closed at one end, and containing a pivoted iron bar, D. The lighter end of the bar has a projection, X, extending outward through the open end of the tube.

This tube is screwed horizontally into a water column, boiler or tank anywhere above the highest water line, so that the projection of the lighter end of the pivoted bar is so placed that the movement of a body suspended therefrom to the water line is unobstructed. This suspended body has such a weight in proportion to that of the heavier end of the bar that the latter will outweigh, or be outweighed by, it, according to whether the body is submerged or not. Therefore, the heavier end of the pivoted bar will be moved between the upper and lower sides of the tube as the alternate rise and fall of the water submerges and uncovers the body suspended from its lighter end.

This movement of the pivoted bar could be made to open and close an electric circuit by direct contact, but in order to do this the contact points would have to be placed within the tube, which would expose them to dampness and corrosion, and consequent leakage of current and liability to failure as well as difficulty in their examination and adjustment.

These obstacles are entirely overcome by placing the contacts outside the tube in a tightly closed box, K, where neither steam, water nor dust can touch them, and the box can be opened for examination at any time.

The box, which is shown enlarged in Figs. 2 and 3, contains a pivoted permanent magnet, N S, with its poles near that part of the tube against which the pivoted bar, D, strikes in its upward or downward movement.

When the iron rod within the tube approaches the magnet poles they are attracted thereby and move towards it, and when the iron rod recedes they are drawn back to their normal position by a counter attraction, whose power over them the iron rod within the tube overcomes when in a favorable position.

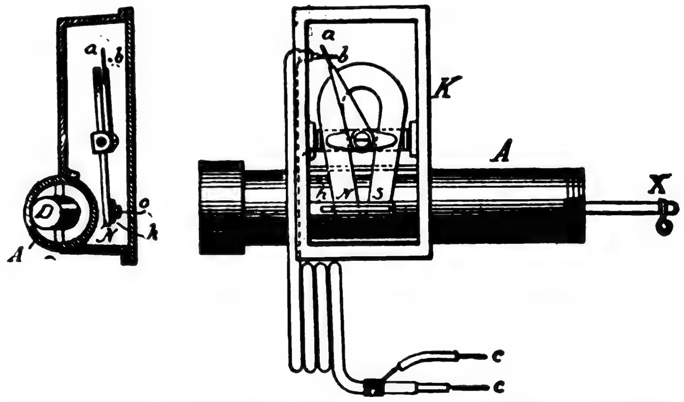
In this manner the motion of the bar within the tube is communicated to the magnet. The motion of the latter towards the tube is stopped by an electric contact, and it is thus made to control an electric circuit, containing an alarm bell.

Thus, when the float is submerged or surrounded by water, the parts occupy the positions shown, but when the water goes down and uncovers it, the movable parts take the positions indicated by the dotted lines in Fig. 1.

In this latter position it will be noticed that the iron rod D, is close to the magnet poles N S, which are thereby attracted and moved towards the tube, bringing the points *a b*, together, thus closing the electric circuit and putting the alarm in operation.

When the water rises and again submerges the float, the reverse operation takes place, and the parts resume their normal positions—the magnet being drawn away from the tube, and against the non-magnetic back stop.

It is evident that the alarm can be applied in a variety of ways to a boiler. Thus, it may be attached directly to the water column, as shown in Fig. 4, which allows of its being tested frequently and with ease. The alarm, we may add, is manufactured by the Ghegan Magneto-Electric Water Alarm Co., of Newark, N. J., and has been fitted to quite a large number of boilers, among them being three in Mr. Edison's laboratory at Orange, N. J.



FIGS. 2 AND 3.—GHEGAN'S MAGNETO-ELECTRIC WATER ALARM.

A PAN-ELECTRIC BILL OF COMPLAINT DISMISSED.

The bill of complaint of J. H. Rogers against ex-Attorney-General Garland and others, involving the ownership of Pan-Electric Telephone and Telegraph stock, was dismissed in the Court of General Term, at Washington, on November 26.

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Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

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VOL. X. NEW YORK, DECEMBER 3, 1890. No. 135

In experimental researches we may learn oftentimes more from our blunders than from our successes.—George M. Beard.

ELECTRIC RAILWAY STEAM ENGINEERING.

IT has been remarked on more than one occasion that the profit or loss in operating an electric light station lies in the management and utilization of the coal pile. This, of course, includes not merely the manipulation of the boilers, but embraces the entire steam plant, not forgetting the engines. Early in the history of electric lighting, when arc lights constituted practically the main system of electric distribution, the nature of the load was to a great extent a steady one, a certain number of lamps being operated on a circuit for a definite time, and then the entire circuit was shut down. This, of course, gave the engine a steady load and permitted of its being worked as a rule to its full rated capacity, with consequent economy. When the distribution of incandescent electric light currents became an established industry, it did not take long to determine the fact that the load had a definite relation to the time of day, and that it varied in such a manner that economy of operation required special arrangements of the engine service. This led to the equipment of stations with what are now known as "units of power." The size of the individual units, of course, varies with the magnitude of the station, the smallest unit being practically equal to the smallest load on the station. But another form of power distribution has sprung up since this question was a mooted one, involving a variety of conditions, the solution of which is of the greatest importance, not only as affecting the economy of operation so far as consumption of coal is concerned, but also as affecting the very life of the steam engine. We refer to the work of steam engines employed in driving dynamos for the operation of street railways. The results of past practice show that the nature of the fluctuations which are here met with can be compared to only one other case, namely, that of the rolling mill engine, in which fluctuations from no load to maximum, and vice versa, take place frequently within a few seconds.

Granted, that an engine can be built which will regulate its speed to take care of the fluctuation in load, will the strains that such service puts upon it allow of its operation without frequent repairs and a comparatively short life? In considering these two factors, the conviction is forced upon us that some radical change in the method of operating the generating plant of electric railways must be forthcoming, and, as a possible solution of the problem, we desire to draw attention to the plan proposed by Mr. C. O. Mailloux, which he details at length in this issue. The ease with which accumulators can be added to electric light plants to assist in taking care of a temporary overload and for equalization of the pressure is sufficiently well known, and the plan has proved so successful in practice that the application of the storage battery to railroad purposes is but a natural step. By the use of a small auxiliary machine and a set of storage batteries, even of the very lowest storage capacity, Mr. Mailloux shows that fluctuations in load exceeding by 100 per cent. the capacity of the main engine can be readily taken care of and involve merely an increase of 10 per cent. in the normal power delivered by the main engine. The system also assures the maintenance of the proper pressure on the line, or, indeed, if desired, may be made to act similarly to an over-compounded dynamo so that the potential on the line may be actually increased with increased load, thus more than compensating for the drop on the line with the heavier currents. As the storage capacity of the battery need be only very small, the ordinary Planté type of cell with thick plates, and whose life is practically indefinite, may, it is suggested, be used. The plan outlined by Mr. Mailloux is evidently so simple that we earnestly hope it will be given a trial by some of the electric railway companies, as there can be little doubt of its success when practically applied.

CHEAP POSTAL TELEGRAPHY.

POSTMASTER-GENERAL WANAMAKER in his annual report touches again upon the question of postal telegraphs. He has been given credit for entertaining some very definite ideas on this subject, but he does not offer any specific plan or scheme this time. He says that the "public imperatively demands cheaper telegraphy," but if that be so, we have rarely heard the imperative demands of a sovereign people made so meekly. Mr. Wanamaker contends that because the government here and in other countries controls the mail service, it ought to control the telegraph. "The general welfare will be similarly promoted by going one step further and giving the quickest of all modes of communication, namely, cheap telegraphic facilities, as it does mails, at points not profitable for private capital to reach, as well as at all other points." But as the government does not own the mail facilities and has to hire nearly everyone of them, including railway trains, stage coaches,

mail wagons, offices, etc., the only control of the telegraphs thus warranted would be that involved in a business contract; and there is no evidence that the Western Union Telegraph Company, or any other, would not be ready to make a contract to do such business at living rates. But no company ought to be expected to do that class of business at a loss. In the case of mail matter, the government does not inflict on the stage coach proprietor the loss that may be incurred in carrying it, but, on the contrary, gives him a satisfactory contract and meets the loss itself, possibly out of profits on other classes or portions of correspondence. Mr. Wanamaker remarks that "the people who pay in postage rates the cost of the postal system have a right to the use of the postal plants as a means of reducing the cost of telegraphic correspondence, and for the instant transmission of postal money orders." But there is a far higher benefit than telegraphic correspondence, and that is the quick bringing together of people so that they do not need to correspond. This benefit may take the shape of telephonic intercourse and even of railway and steamship travel, so that Mr. Wanamaker might with more propriety ask that postoffice surpluses should be spent in the perfection of long distance telephony, and in the development of fleeter "ocean greyhounds."

MATTHIESSEN'S STANDARD.

The preliminary report of the Standard Wiring Table Committee submitted to the American Institute of Electrical Engineers will be read with much interest by all whose work involves the determination of the resistance and weight of conductors for electrical purposes. While the exact value of the "legal ohm" is still a matter of some uncertainty, and, as we have seen, has been subjected to various changes within a comparatively short time, a practical standard, even if not absolutely exact has a *raison d'être*, and the more so as in the case of the Matthiessen standard, it is expressed in terms, and given for the value, of the metal most commonly employed in electrical work. Although, as has often been shown, the modern perfected processes of copper reduction have resulted in the production of wires exceeding 100 per cent. of the Matthiessen standard, the Committee point out that the objection which this might give rise to is offset by the advantage that commercial wires will appear the better for being compared with the lower standard. With the standard of resistance thus fixed upon, it is to be hoped that the Committee will soon be able to hand in its complete report on the standard wiring table, than which no more important subject in that special direction can occupy the attention of the Institute.

Training for the Next Execution.

The newspapers have published many details during the past week as to the preparations for the next electrical execution at Sing Sing, to take place, presumably, this week. We are told that various improvements in the methods and devices have been made, and that, this time, within two minutes after he leaves his cell, the prisoner will have been killed by the current. In spite of the cocksureness that is felt, it has been deemed advisable, however, as before, to try the current on some innocent animal, and on this occasion a strong, healthy horse was sacrificed. Perhaps the opponents of vivisection will have their attention arrested by this peculiarity of electrical execution by and by, and interfere. Such experiments with apparatus properly installed, for ordinary work, are quite unnecessary, and there is no reason why they should be allowed when the object of the execution is to teach the value and sacredness of life. May be horses, dogs and cattle don't count.

Travelin Facilities in New York City.

The all season has found the accommodations of the Manhattan Elevated system more inadequate than ever to the wants of the community. It is true that the crushing and crowding have been denied, but these are things of whose existence one has unfortunately to judge for one's-self. Travel on the Elevated becomes daily less endurable, and the need for better facilities cannot much longer go unfilled. It is this knowledge that has caused the press to give so much space to the new electrical underground road in London. The many features of advantage of electricity for locomotion when presented thus concretely are quickly grasped, and there has naturally been expressed a wish to see something of the same kind in New York. The fact is this city wants a reproduction of the London underground system, minus its steam locomotives, and unless such a road is built there will be no comfort in travel at all. With electric lights, electric motors and electric ventilators, an underground road in this city would be a great boon, relieving the streets of noise and gloom and dirt and enabling passengers to go quickly from one end of the Island to the other.

Electric Car Gear.

The numerous methods designed in the past and described in our columns might make it appear to be difficult to devise new ones for connecting the armature of the street car motor to the axle, but the variety and scope open to the inventor are such that new devices are brought out every week. A most ingenious one of its kind is that which we describe on another page, due to Mr. Mark W. Dewey. Utilizing the principle of the Arago disc, Mr. Dewey employs the electro-dynamic interaction between a magnet and a conductor in its neighborhood to transfer motion from the armature to the car axle. Of course the question of efficiency of transmission must naturally enter into the problem and upon this point it would be interesting to learn of the results of experiments.

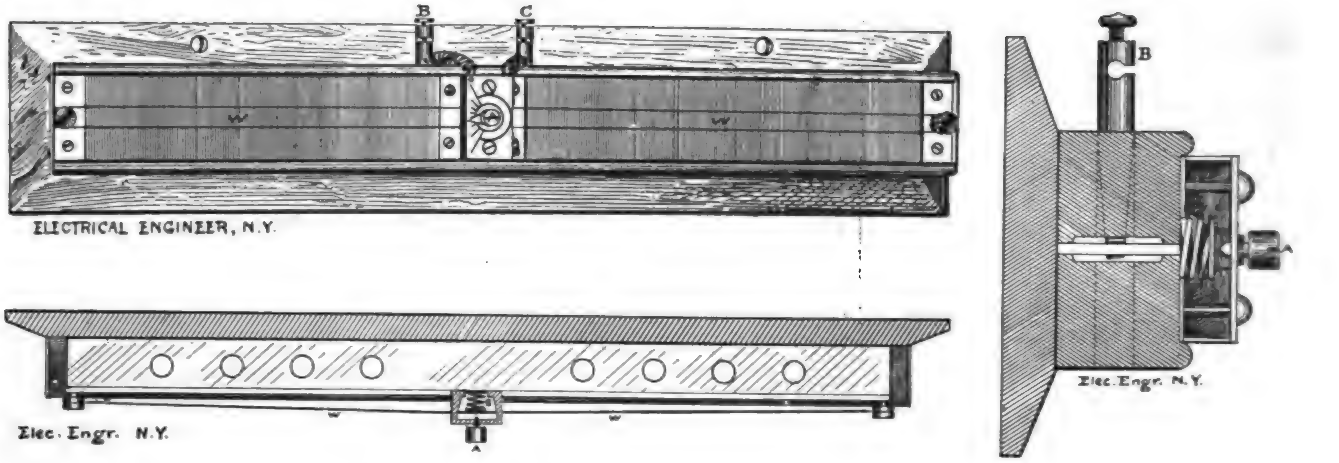
The Electrical Corps.

The suggestion put forward by Lieut. Bradley A. Fiske for the establishment of an electrical corps as an adjunct to the State National Guard, to assist in naval and military operations in time of war, has begun to attract notice. In his report to Congress, Secretary Tracy calls attention to the plan, and his language is that of approval. The corps would be, he says, especially valuable in wartime in fitting out new ships with electrical apparatus and in taking charge of plant on board ships in commission. In a recent letter to one of the editors of The Electrical Engineer, Secy. of War Proctor suggests, however, that the matter is one upon which the State authorities would have to act, and that it is doubtful whether the "arms and equipments" issued by the general government could include electrical apparatus.

PETIT & BRESSON'S FIRE ALARM THERMOSTAT.

The phenomenon of the expansion of solids and liquids by heat has been applied in a variety of ways to the construction of thermostats for the purpose of closing an electric contact following upon a definite rise in temperature. This method evidently permits in a very simple manner of detecting at once the starting of a fire and of giving the alarm electrically. Evidently the desired qualities in a thermostat are sensitiveness to rise in temperature and certainty of action. On the other hand, however, much annoyance has been caused by supersensitiveness in such apparatus, in virtue of which their contacts are closed by the vibration or jar in buildings so that an alarm is sent in when no fire exists. This has on more than one occasion given rise to carelessness in the attendants, who, being deceived a number of times, have, in a critical moment, been slow to act and hence caused considerable loss.

It was with the object of affording a sensitive thermostat, which at the same time should not be affected by jarring or other extraneous causes, that Messrs. Petit and Bresson, of Vittoria, Spain, have designed the apparatus illustrated in the accompanying engravings. As will be seen, the instrument, which is shown in perspective in Fig. 1, and in longitudinal and transverse section in Figs. 2 and 3, consists of a pair of looped wires w w which are kept taut by a spring s, the wires passing over a cover plate. The spring, with the plate, is in contact with one of the binding posts B. Passing through the cover of the spring is a screw A which is normally out of contact with the plate covering the spring, and which is connected to the other binding post C. Any increase in the temperature, of course, expands the wire w, which is pushed forward by the spring s and makes contact with the screw A opposite it. This closes the circuit and sends in the alarm.



Figs. 1, 2 and 3.—Petit and Bresson's Fire Alarm Thermostat.

It will be evident that the instrument can be made to send in the alarm at any desired elevation in temperature by properly regulating the distance of the screw A from the plate covering the spring over which the wires pass. The screw, it will be noticed, carries a pointer passing over the graduated circle upon which are marked the degrees in rise of temperature at which the alarm can be set. In this way the instrument can be used for a variety of purposes, not only for indicating the breaking out of fire, but also in dry-houses, and the like, where the temperature has to be kept at a certain definite limit The apparatus is very simple and has already been extensively applied in Spain in the Government bureaus and other public buildings.

The Highland Park Electric Light Company, Chicago, have adopted improved Candee wire for their primary circuits throughout their system, and have over 15 miles of it in use. They report that recently after three days of continuous rain a test showed that the insulation resistance of the primary circuits was over 1 megohm, notwithstanding the fact that the wire are built through alleys and in a great many cases hang through trees.

THE DISCHARGE OF ACCUMULATORS LEFT ON OPEN CIRCUIT.[1]

BY GASTON ROUX.

When it is not required to make use of a battery of accumulators during a certain period, what must one do to prevent them from being injuriously affected? That is a question which has often been put to me, and to which I have always replied: "Charge the battery to 'saturation,' and leave it to itself." I am aware that this is not the opinion of everyone, and that some recommend that accumulators should be charged to "saturation," and the liquid then emptied out, while others advise substituting pure water for the ordinary solution, and others still the substitution of concentrated acid for the ordinary solution. My opinion was based upon an experiment which I carry out each year at the Ecole de Physique et Chimie Industrielles de la Ville de Paris during the summer holidays. The experiment was repeated as usual this year, and I determined the exact amount of charge lost by the accumulators left on open circuit. The tests were made on two storage cells of the Julien type, having a capacity of 200 ampere hours, which were separated from the remainder of the battery. These accumulators are provided with paraffin spray arresters. The cells are of glass, and are contained in wooden boxes filled with sawdust, and supported on oil insulators. The cells, therefore, are thoroughly well insulated. The solution has a density of 1.2, when the cells are fully charged, and contains 6 per cent. by volume of saturated sulphate of soda.

The two cells were charged to saturation on August 5th, discharged on August 6th, and recharged on the 7th of the same month. I then left them to themselves until October 20th, that is to say, for two months and 13 days, when they were discharged. The discharge was stopped both on August 6th and October 20th, when the E. M. F. had fallen to 1.8 volts per cell. The quantity of electricity was found to be 233 ampere hours on August 6th, and 220 ampere hours on October 20th. Assuming that in each charge the accumulators stored the same quantity of electricity, we may conclude that the accumulators only lost on open circuit 13 ampere hours, or 6 per cent. of their charge during two and-a-half months. This result seems to me to prove that accumulators well made, well charged, and well insulated, are not injured by being left on open circuit. It also shows the good quality of these particular cells, and proves again that there is no local action between the active material and the antimony alloy supports. I should have liked to have carried out a similar test on accumulators with plain lead grids, but I had none at my disposal.

SOUNDINGS FOR THE NEW PACIFIC CABLE.

Information has just been received of the second season's work of her Majesty's war ship "Egeria," which has been detailed to make a systematic examination of the bed of the Pacific Ocean, with the object of discovering the best route for a cable from Canada to Australia. Last year was spent at Auckland, New-Zealand, and the Fiji group. The deepest sounding obtained south of the equator was 4,530 fathoms. Unfortunately, the nature of the bottom at this great depth was lost through the wire parting when heaving in. Three islands of the Phœnix group were surveyed in sufficient details to ascertain their suitability for a telegraph cable. The vessel is now further engaged with the survey of the work, and the British flag has been hoisted on all islands visited in the Pacific which are not under the protection of any other power.

1. *L'Electricien.*

THE CARPENTER-NEVENS ELECTRIC CAR HEATER.

We illustrate on this page a new electric car heater, now being introduced by Mr. C. B. Hanna, the general agent for the Carpenter-Nevens Electro Heating Co., of Minneapolis. We are indebted to the *Street Railway Gazette* for the illustrations.

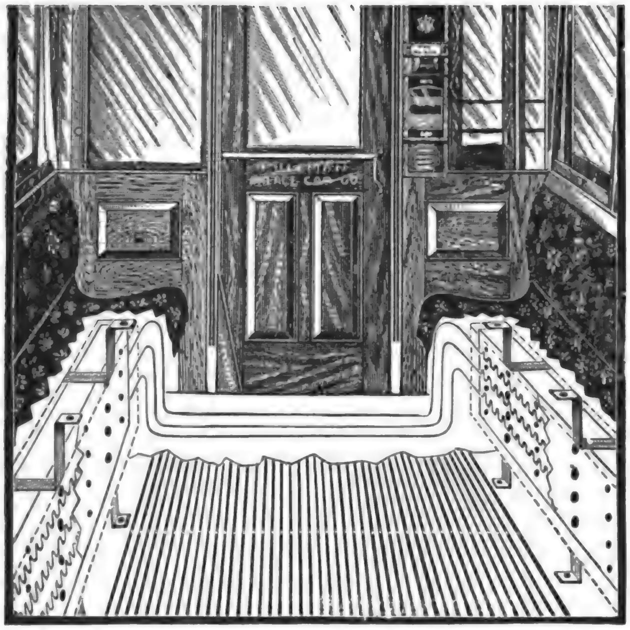


Fig. 2.—Carpenter-Nevens Electric Car Heater.

The heater, as shown in Fig. 1, consists of a narrow strip, or ribbon, of asbestos enclosed in sheet iron, about 3 in. in width and about ½ in. in thickness, which is intended to extend from one end of the car to the other, under the seats, on both sides, midway between the seat and the car flooring, and protected from the person or clothing of the passenger by a wire screen. It is enclosed on all sides except the face in a copper radiator or reflector in order to divert the heat into the proper channel and to protect against loss. A second strip of iron of the same dimensions is attached to the first strip by a single row of small bolts extending from end to end, thus serving the purpose of a compressing plate and, at the same time, forming the other side of the heater. The resistance wires are imbedded in asbestos, and the compression plates are bound firmly together by means of the small bolts before mentioned, and are located between the two strips of iron. Three or more resistances, of zigzag form, are used which not only extend from end to end of the heater, but are also connected with companion resistances in the other heater on the opposite side of the car, so that a single resistance extends not only down one side of the car in both heaters, but also around the car on both sides. In other words, it is intended that from two to three resistances, each one in parallel and independent of the other, extending from end to end of the heater, but each one connected in series with that of a companion on the opposite side of the car, shall be used, in order that, when the circuit is closed upon one of them a certain current will flow, which, of course, with the given number of volts, is inversely as the resistance. The heat resulting from the flow of the current through the resistance becomes equally distributed on both sides of the car from end to end, thus equalizing the amount of heat evolved. Since two or more resistances are then in the circuit, so, if three resistances are cut in the circuit, the amount of heat will be increased again over that of the other two, and if these resistances have the same number of ohms under all conditions, there will be three times as much current consumed and consequently, three times as much heat evolved as when only one resistance alone is used in the circuit. This provision is made in order that the heater may be adapted to any kind of climatic or atmospheric conditions.

With regard to the amount of power required to generate the requisite amount of electricity for the development of the required temperature, it is claimed that 9 amperes of current at 500 volts, equal to about 6 to 7 h. p., are used at first, but only for a few minutes, after which but 1½ amperes are used.

The current is controlled by the motor-man.

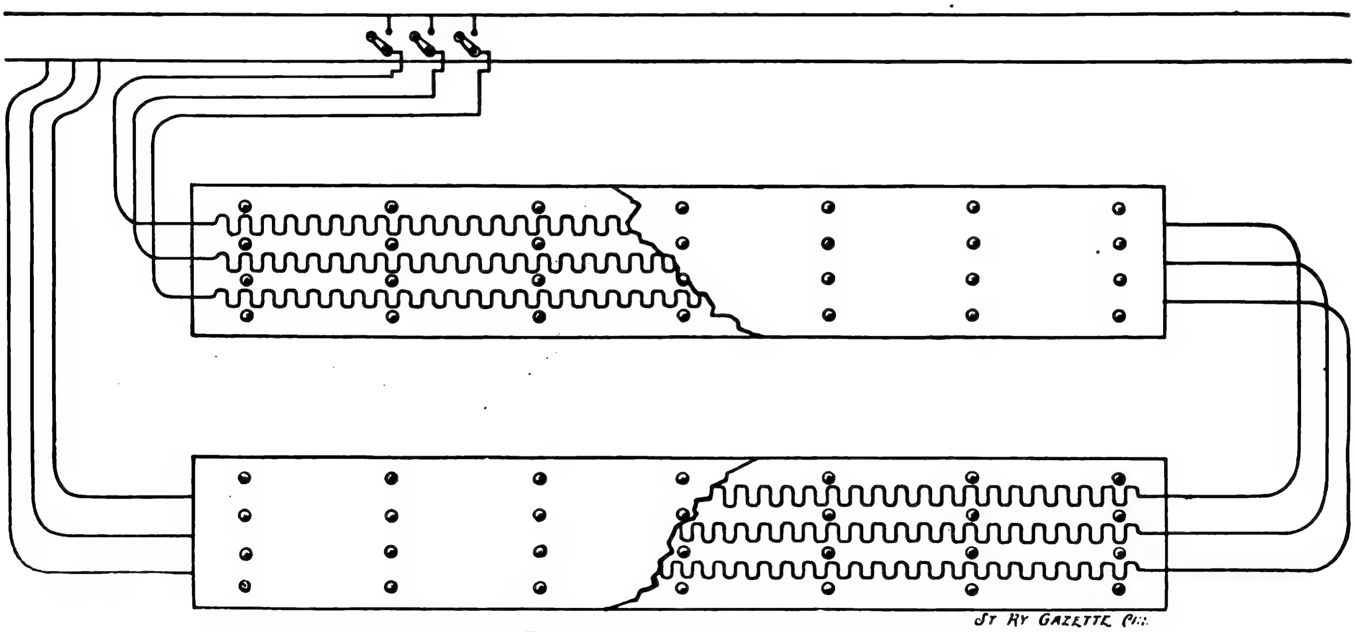


Fig. 1.—The Carpenter-Nevens Car Heater.

Fig. 2 shows the heater as placed on the Pullman street car—a section of the seat having been removed in order to afford a view of the heater in position.

A PROPOSED CABLE TO FLORIDA.

An English company has submitted a proposal to lay a cable from Nassau to the Florida coast in consideration of an annual subsidy from the colony. Details of the project are not yet made public. It is thought that the Legislature, which is to meet in extra session, will accept the proposition.

VAN DEPOELE'S ELECTRIC RAILWAY BRAKE.

MR. C. J. VAN DEPOELE, not content with his many inventions in electric traction, has been giving attention to electric railway brakes. One of his recent inventions is shown in the accompanying engraving. Mr. Van Depoele deems previous devices to be for the most part wasteful of electric energy, inasmuch as they have frequently depended upon the employment of artificial resistances as means for controlling the currents actuating the brake mechanism, and seeks to make a more efficient apparatus by employing the counter-electromotive force from a subsidiary motor.

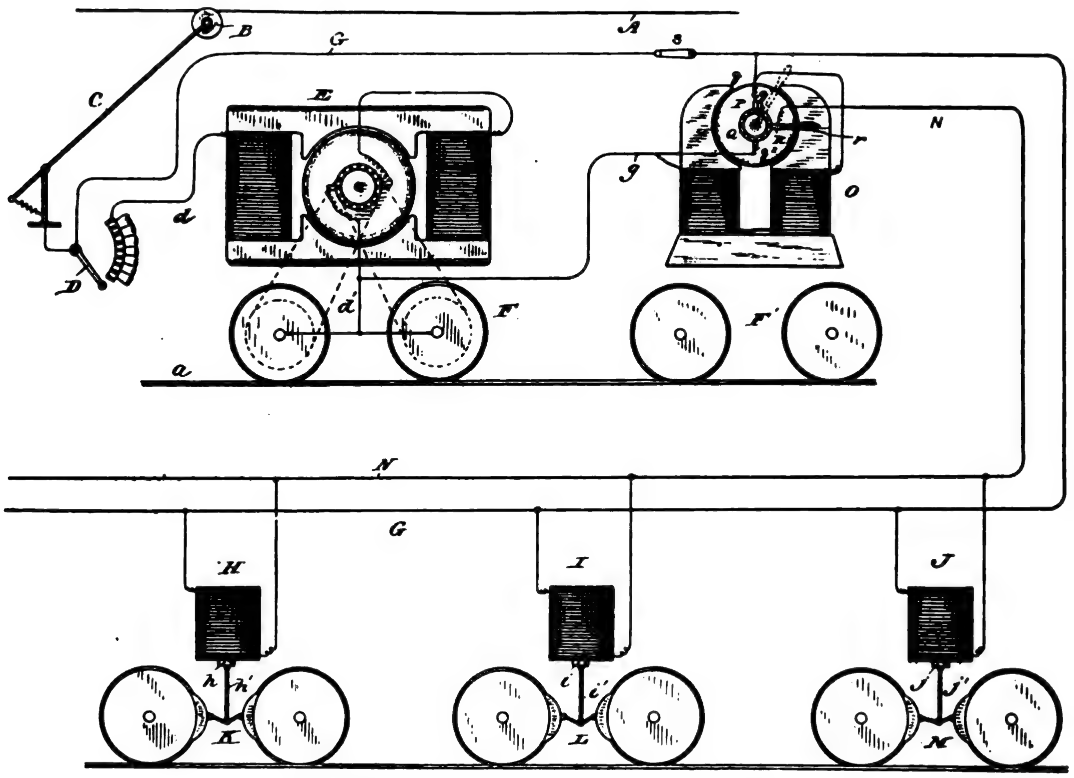
This method is said to secure the most delicate adjustment and control, and includes no dead resistances which would be liable to become overheated, or destroyed by the continuous use frequently required of brake apparatus.

The apparatus is illustrated in connection with a number of electric-railway vehicles.

A represents the supply-conductor of an electric railway, B a contact device from which current is carried down the trolley-pole C to a switch D, through which it may pass by which the car or train is controlled, in position to be easily reached by the motor-man.

The motor O is provided with the usual sectional commutator Q, which is provided with main positive and negative brushes q' q^2, and also with a third commutator-contact in the form of a movable brush R, supported upon a hand-lever r, mounted concentric with the armature-shaft q. The positive commutator-brush q' is connected to and receives current from the branch conductor G. The opposite main brush q^2 is connected with the return-circuit of the system represented by the grounded conductor d'. The field-magnet circuit of the motor O is connected to the main commutator-brushes in derivation, the motor being operated at constant speed.

All current passing through the solenoids must flow through the conductor G, returning by way of the conductor N and movable brush R. Consequently the position of R with respect to the main brushes of the motor O will determine the amount of current which can flow through the circuit G N. When the movable brush R is opposite to the main brush q', no current whatever will flow in the circuit G N. As soon, however, as the movable brush is



VAN DEPOELE'S ELECTRIC RAILWAY BRAKE.

conductor d to the coil of a motor E for propelling a motor-car, the car being indicated by the wheels F F'. One side of the circuit is represented by the conductor A and the other by the rails a of the track. The circuit of the motor E is connected to the track through conductor d'. From the switch D extends a branch conductor G, which traverses the working-circuit shown as a train to be electrically braked.

A number of sets of brake mechanism K L M are shown, represented by solenoids H I J, each provided with an iron plunger h i j, mechanically connected with the brake mechanism by connecting-rods h' i' j'. One terminal of the brake-actuating solenoids is connected with the conductor G, the other terminals being connected to a second conductor N, the solenoids being therefore in multiple-arc relation to each other and to their supply-circuit. The subsidiary motor O, whose counter-electromotive force actuates the brakes, is, for convenience, located upon the motor-car or at or near the point from moved away from the brush q' current will begin to flow in the working-circuit, the electromotive force increasing continually until the moving brush is in position alongside the other stationary brush q^2, when the current will flow through the circuit G N and traverse the solenoids H I J to the full extent of their capacity. Thus, by moving the brush R between the stationary brushes q' q^2 the current in the brake or other working circuit can be regulated with great precision, eliminating wasteful resistance, as well as delicate parts. The motor O may be a quite small one, its size depending upon the extent and capacity of the working circuit. It is obvious that the armature of the motor need only be in motion during such time as the brake is in use, although it may be found desirable to keep it constantly in motion in order to be prepared for emergencies. A switch s is provided in the conductor G for opening the brake-circuit when desired.

It will be seen that Mr. Van Depoele's invention is not limited to employment upon electrically propelled cars, but

may be used on steam or other railways, if a suitable electric generator be provided for operating the brake-setting device. It is also clear that no particular form of brake-mechanism is requisite, but that many varieties might be used.

PRELIMINARY REPORT OF THE STANDARD WIRING TABLE COMMITTEE,[1]

IN REGARD TO MATTHIESSEN'S STANDARD OF RESISTANCE OF COPPER.

The Council of this Institute at its regular monthly meeting held December 3rd, 1889, appointed a committee "to formulate and submit for approval a standard wiring table for lighting and power purposes."

The committee appointed consists of the following members of the Institute: Thomas P. Conant, Dr. Louis Duncan, Prof. Wm. E. Geyer, A. E. Kennelly, George B. Prescott, Jr., E. Wilbur Rice, Jr., Prof. E. P. Roberts, Prof. Harris J. Ryan, William Stanley, Jr., Dr. Schuyler S. Wheeler, and Francis B. Crocker, chairman. This action was taken by the council with the object of overcoming or reducing the great confusion which now exists in regard to the standards and constants of electric conductors.

At the first meeting of the committee held January 10th, 1890, it was decided to confine the work at first to the three subjects of Standard of Resistance, Temperature Coefficient, and Safe Carrying Capacity of Copper, since these are of fundamental importance.

The subject of Matthiessen's Standard alone is so confused and involved, and the discrepancies are so great between the best authorities, that the committee has devoted its attention almost entirely to this subject up to the present time.

After a very thorough investigation of Matthiessen's work with a view to ascertaining what his standard really was, by a sub-committee, consisting of Prof. Wm. E. Geyer, Mr. George B. Prescott, Jr., and the chairman, the conclusion has been reached that Matthiessen's "Mile Standard" (one statute mile of pure copper wire 1-16 inch. in diameter has a resistance of 13.59 B. A. units at 15.5° C.) is not the true one although very commonly used. We consider the correct Matthiessen's Standard and the one in which he, himself, had most confidence was the "metre-gramme" standard (resistance of pure hard-drawn copper wire, one metre long weighing one gramme = .1469 B. A. unit at 0° C.). This has the disadvantage that it is expressed in terms of weight instead of diameter. It is, however, very much more difficult to get the exact mean diameter of a wire than to get its exact weight, as Matthiessen himself states. Furthermore, by selecting the most reliable constants given by Matthiessen and corroborated by investigation and correspondence with the best authorities, we have by calculation converted this "metre-gramme" standard into a standard referred to dimensions and independent of weight, which is the form generally used.

The various constants selected, the method of calculation, and the values deduced are given in a table at the end of this report.

As to the fact that wires may be found which test 102 per cent. of Matthiessen's standard or even higher, we are of the opinion that this is no real objection provided the value of the standard is definite and generally accepted. A standard which is not the highest attainable value may even be considered an advantage since the average commercial wires will approximate to it more closely.

Although we believe the standard we recommend will answer the purpose temporarily and probably permanently, nevertheless we think that if a thoroughly correct and complete redetermination of the standard resistance of copper could be accomplished, it would be a benefit to electrical science and industry. Favorable offers in this direction have already been received by this committee from Johns Hopkins University, Cornell University and Columbia College, and it is very likely that this redetermination may be undertaken.

This committee purposes next to take up the subject of the safe carrying capacity of wires.

Matthiessen's standard recommended by this committee is:

A hard-drawn copper wire 1 metre long weighing 1 gramme ("metre-gramme") having resistance of .1469 B. A. unit at temperature of 0° centigrade.[2]

From this standard we calculate by taking the value 8.89 for the specific gravity of copper, that a hard-drawn wire 1 metre long and 1 millimetre in diametre ("metre-millimetre") has a resistance of .02104 B. A. unit at 0° C. This value is also given by Matthiessen.[3]

Matthiessen's figures[4] for relative conducting power are:

Silver	100
Hard or unannealed copper	99.95
Soft or annealed copper	102.21

From these the resistance of hard copper is found to be 1.0226 times that of soft copper; therefore the resistance of a soft copper wire 1 metre long and 1 millimetre diameter is .02057 B. A. unit at 0° C.

From this the resistance of 1 cubic centimetre of soft copper is found to be .000001616 B. A. unit at 0° C.

And the resistance of soft copper wire 1 foot long and .001 inch in diameter (mil-foot) is 9.720 B. A. units at 0° C.

Taking one B. A. unit as .9889 legal ohm, any of the above values may be converted into legal ohms. To find the conductivity of copper at temperatures other than 0° C., Matthiessen's formula may be used $C_t = C_0 (1 - .00387\,t + .000009009\,t^2)$.

Table of values based upon Matthiessen's correct standard.

	B. A. Units. 0° C.	Legal Ohms. 0° C.
Matthiessen's Standard metre gramme hard	.1460	.1453
Metre-gramme soft	.1436	.1420
Metre-millimetre hard	.02104	.02080
" " soft	.02057	.02034
Cubic centimetre hard	.000001652	.000001634
" " soft	.000001616	.000001598
Mil-foot hard	9.940	9.829
" soft	9.9720	9.612

Specific resistance of hard copper (1 cub. cent.) = 1634 C. G. S. units.

Specific resistance of soft copper (1 cub. cent.) = 1598 C. G. S. units.

Matthiessen's standard specific gravity of hard copper, 8.89.

Resistance of hard copper is 1.0226 times that of soft copper.

Resistance of soft copper is .9779 times that of hard copper.

Legal ohm is equal to 1.0112 B. A. unit.

B. A. unit is equal to .9889 legal ohm.

F. B. Crocker, Chairman.

1. This report has been revised in accordance with the instructions of the meeting of Sept. 16th, 1890.
2. *Philosophical Magazine*, May, 1865.
3. *Philosophical Magazine*, May, 1865.
4. *Philosophical Transactions*, 1864.

ELECTROLYSIS OF ANIMAL TISSUES.[1]

BY G. N. STEWART

A preliminary account of part of the work was given in the Proc. Roy. Soc. Edin., 1888, and a short description of later results at a meeting of the Physiological Society at Cambridge in March last. The full paper is being published in a volume of memoirs from the physiological laboratory of the Owens College, Manchester. The chief results are here summarized:

(1) The first part of the research was directed to answering two questions: (*a*) *Is the conduction in animal tissues entirely or chiefly electrolytic?* (*b*) *What are the electrolytes?* It is shown that by far the greatest part of the conduction at any rate is electrolytic, and that the best conductors by far are the inorganic constituents of the tissues. Next to these, but at a great distance, come some of the nitrogenous metabolites. The proteids are exceedingly bad conductors.

(2) *The changes produced in simple proteid solutions* were next investigated. It is shown that the proteids are affected not by primary electrolysis, but by the products of electrolysis of the salts.

The effects vary to some extent with the current density. In solutions of coagulable proteids alkali-albumin is formed at the cathode, and acid-albumin at the anode, some of the proteid being coagulated at the latter.

(3) *The effects of electrolysis on isolated tissues and on some of the liquids of the animal body.*

Striped Muscle.—Great changes were found in the microscopic appearance of the fibre. The nuclei became very prominent in those near the anode, with apparent coagulation of the sarcous substance, suggesting the action of a dilute acid. At the cathode the fibres were more homogeneous than before. The striation was impaired. Chemically, the same changes in the proteids were found as in simple proteid solutions, and a distinct effect on the distribution of the salts was made out, by estimating the ash in different parts of the muscle.

Blood.—Entire defibrinated blood, blood serum, and pure hæmoglobin solutions were used. There was no indication that hæmoglobin, or any derivative of it, acts the part of an ion. At the anode the reaction becomes acid, and acid-hæmatin is formed, which remains partly in solution and is partly thrown down, the solution becoming less deeply colored. When the current is strong or long continued the hæmatin suffers further change and is decolorized, apparently by the oxygen or chlorine set free. If a reducing agent is present at the anode, the hæmoglobin there is not affected by the electrolysis. At the cathode alkali-hæmatin is ultimately formed, although its less definite spectrum does not show itself so soon as that of acid-hæmatin at the anode. The proteids of the serum and corpuscles are partly coagulated at the positive pole. At the cathode they are partly changed into alkali-albumin.

1. *Nature.*

Bile and urine were taken as further examples of animal liquids.

(4) *The effect of electrolysis in the living body.*

Pithed frogs and anæsthetized rabbits were used. This part of the work is still incomplete.

THE MAGNETO-OPTICAL GENERATION OF ELECTRICITY.[1]

BY SAMUEL SHELDON, PH.D.

WHILE experimenting upon the effects of alternating currents of electricity upon the plane of polarized light, results were obtained which made it feasible to try a series of experiments, in which the Faraday arrangements were reversed. Although the series is incomplete, yet the little that has been accomplished seems worthy of publication.

It is well known[2] that if a beam of plane polarized light be passed through a tube containing bisulphide of carbon, and if the tube and beam lie in the direction of the lines of force of an electromagnet about to be excited, the plane of the emergent beam will be rotated upon exciting the magnet. The direction of rotation will be the same as that of the exciting current, and the amount of rotation will depend upon the strength of the current. If the current be reversed the plane will be rotated in an opposite direction and by exactly the same amount. Thus the rapidly alternating current would produce a rapid swinging to and fro of the plane of light.

Now, if a difference of potential, under these conditions, produces such a rotation of the plane, why should not a rapid rotation of the plane, under exactly the same conditions, produce an inverse difference of potential between the terminals of the coil? A continuous rotation should produce a continuous current of electricity and an oscillating of the plane an alternating current. The experiments which have been performed verify the latter supposition.

The coil employed was wound upon a thin brass tube as a core. This was closed at each end by plates of glass and was provided with holes for filling with carbon bisulphide. Its length was 175^{mm} and its diameter 23^{mm}. Upon this was wound the coil from double silk-covered copper wire of 0.85^{mm} diameter. When wound the length of the coil was 150^{mm} and its diameter 45^{mm}. The resistance was 7.21 ohms.

A quantitative measurement of the Faraday effect was first made and in the following manner: A beam of light from an incandescent lamp, after passing through a large nicol, was made to traverse the bisulphide of carbon in the coil. Upon emerging the beam was brought to extinction by the proper adjustment of an analyzing nicol. A measured current of electricity was now passed around the coil. This necessitated a readjustment and rotation of the analyzing nicol to reproduce extinction of the beam. Within the limits tried this rotation was proportional to the current strength. As a mean of many measurements it was found that a current of 1 ampere required a rotation of 78 minutes of the analyzer. Accordingly 278 amperes would be required to rotate the plane through 360°, providing the proportionality between current strength and rotation remained unaltered.

Now, if we consider a plane polarized ray of light to be made up of two opposite circularly polarized rays, then a particle of ether in the bisulphide of carbon describes a simple harmonic oscillation in a plane. This motion in a straight line is the resultant of the two oppositely directed, equiperiodic, circular rotations of equal amplitude. If now a magnetic field be created, the particle undergoes an instantaneous circular electric displacement which results in the retardation of one and the acceleration of the other component rotation. The line of oscillation suffers rotation as a result, and assumes a new position. The displacement must be instantaneous, for, were it continuous, the line of oscillation would continue to rotate and the analyzer could not be made to produce extinction. If now, instead of allowing the magnetic field to produce this circular displacement, we superimpose, by mechanical means, a third rotation upon the two existing components, then a magnetic field should result and an electromotive force be induced in a coil surrounding that field. Such a result would be obtained by rotating the polarizing nicol. The rapidity of rotation must be very great, and, if it requires 278 amperes (an impressed electromotive force of 2,000 volts) to rotate the plane through 360°, then to produce this electromotive force the polarizer must be revolved with a frequency of the same order as of the oscillations of light. But a nicol cannot be revolved much above 200 times per second. The centrifugal force resulting from a higher rate will, owing to the strain produced, interfere with the performance of its functions as a polarizer. This rate of 200 revolutions per second would produce, in the apparatus employed, an electromotive force of perhaps 0.000000001 volt, giving a current too small to be detected by any galvanometer in my laboratory. Hence use was made of the extreme delicacy of the telephone as a substitute, and a swinging of the plane instead of a revolution.

The arrangement of apparatus was as follows: Light from an arc lamp, after passing through a large nicol, was reflected, at a very obtuse angle, from a small movable mirror and then passed through the bisulphide of carbon in the coil before mentioned. The two terminals of the coil were carried to a room three stories below and in another part of the building. Here they were connected through a telephone and a switch. The mirror (10×30^{mm}) was fixed in a brass frame free to rotate about an axis nearly parallel with the ray of light. This frame was connected by an eccentric and gears to the main shaft in the work shop. By this arrangement the mirror was made to oscillate through 45° about 300 times each second. The plane of polarization was thus twisted through twice that amount, or 90°, in the same time. While this oscillation was going on in the workshop, an ear placed at the telephone at the other end of the circuit could easily distinguish a tone, which, however, was the octave above that made by the moving mirror. When the circuit was broken the sound ceased to be heard, but upon again closing the tone became audible. With a rate of 200 oscillations per second the note was not so easily distinguished. But upon closing the circuit that peculiar sizzling noise so common in telephone circuits was heard.

During the experiments the mirror was frequently broken by the high rate of vibration. But another was quickly substituted by my assistant, Mr. Baker, whom I have to thank for this and the construction and management of the rotating apparatus.

1. *American Journal of Science.*
2. Faraday, Exp. Res. 2146, vol. iii, p. 1.

REPORT OF THE B. A. COMMITTEE ON ELECTRICAL STANDARDS.[1]

THE first paper was by Mr. Glazebrook himself, "Variation in Some Standard Resistance Coils." The repeated careful comparisons show an excellent constancy of five of the eight coils; there are very slight deviations, for which a temperature error of ¼ degree would account. But the coil F, which, like the coils G and H, consists of a platinum silver alloy, has not recovered its character; it has long been distrusted and now shows a gain in resistance of .0007 B. A. unit, a deviation, it will be granted, noteworthy only in the case of a standard coil. As the insulation resistance is perfect, Mr. Glazebrook ascribes the error to a contraction of the paraffin, the coil being probably mechanically damaged in handling. The other two platinum-silver coils have also lost .0002 and .0001 B. A. unit respectively; and some speakers did not trust the alloy. Professor Perry has twisted flat strips of one wire of this alloy, and found them anything but equal in behavior; and Mr. Glazebrook will be glad to have any such coils back for re-examination. The new coils are wound without solid paraffin to avoid any chance of mechanical damage.

The second paper by Messrs. Glazebrook and Muirhead, "Some Standard Air Condensers," reported the completion of two air condensers after Muirhead's pattern. They consist of 24 concentric brass tubes, $\frac{1}{16}$ inch thick; outside diameter, 1 foot; height, 3 feet; leaving ¼ inch air space between tube and tube, connected to two parts of twelve alternate tubes. The joint pieces are also brass, the insulation ebonite. The condensers have a capacity of .02 microfarad each, and have been tested by Maxwell's method in August and December last year, and May and June this year. The one condenser proved excellent and loses about one-thousandth of its charge per minute; the other seems a little faulty. The fourth paper "Comparison of a Platinum Thermometer with Some Mercury Thermometers," gave further details and curves respecting this most delicate thermometer of Mr. R. H. Griffiths; the Kew thermometer is still always $\frac{1}{100}$ degree lower.

Mr. Fitzpatrick contributed the third paper "On the Specific Resistance of Copper." The wires tested were about 1 metre long, and weighed 1 gramme, and the bridge arrangement adopted determined the length of that wire of one-thirtieth ohm resistance. The specimens were supplied by Messrs. Sutton and other manufacturers, and by Mr. Fitzpatrick himself, who electrolyzed carefully purified copper sulphate. His and Sutton's pure copper gave the resistance of Matthiessen, 1767×10^{-9} B. A. unit at 18 degrees; the specific gravity of this copper was 8.9. Other copper wires of specific gravity 8.940 and 8.946, understood to be Elmore's, had resistances still lower by 2 and 2.4 per cent., the respective figures being 1731 and 1724; the greater conductivity was due probably not to greater purity, but to the greater density. The report recommended the adoption, as a standard of resistance sufficiently near the absolute ohm for practical purposes, the resistance of a mercury column of 1 square millimetre section and 106.3 centimetres length; this would give .98656 or in round figures .9866 as the ratio of the B. A. unit to the ohm. This corresponds to .9535 B. A. unit as specific resistance of mercury, and to a mercury column of 104.87 centimetres length as representing the resistance of the B. A. unit.

Twenty-eight towns in the departments of France have now obtained telephone service. In eight other towns the telephone lines are in construction and will be completed in two months' time. Other towns will shortly be added. There are only two towns possessing telephones in Algeria, viz., Algiers and Oran.

1. Presented at the British Association Meeting, Leeds.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.

Anonymous communications cannot be noticed.

The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.

In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.

Sketches and drawings for illustrations should be on separate pieces of paper.

All communications should be addressed EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

METHODS OF TESTING TRANSFORMERS.

[147.] I have read in your issue of Nov. 12, the discussion of Messrs. Tobey and Walbridge's paper on the Stanley alternating current dynamo. In the discussion Dr. Carey T. Hutchinson drew attention to the fact that experiments, similiar to those described in that paper, and also very much like Prof. Ryan's and Messrs. Humphrey and Powell's work on transformers, had been made at Johns Hopkins University several years ago, and that in spite of this no reference had been made by these gentlemen to the work of the previous investigators.

To quote Messrs. Powell & Humphrey's paper: "It is worthy of mention that this method which gives something so definite and fundamental in the treatment of alternating currents, has only come into use within the past year." The method referred to is spoken of as Prof. Ryan's method.

That the work on transformers done at Cornell is valuable is unquestioned, but the disposition manifested to claim as original, in 1890, a method which was not new in principle in 1887, is not to be commended If the method referred to be compared with that used by Messrs. Hutchinson, Wilkes and myself in 1887, and fully described in *The Electrical World* (March 31, 1888, et seq.,) it will be seen that they are practically identical, and the results of our work, which dealt with open and closed circuit transformers under various conditions, are closely the same as those given by the later investigators. LOUIS DUNCAN.

JOHNS HOPKINS UNIVERSITY,
BALTIMORE, Nov. 18.

THE EFFECT OF SHIFTING THE BRUSHES.

[148.]—Will you kindly decide for me in your next issue this mooted question: Why does the raising or lowering of dynamo brushes—changing their position on the commutator—increase or diminish the current both in arc and incandescent machines?

INQUISITIVE.

New York.

[The diminishing of the current is a secondary effect caused by the lowering of the difference of potential, when the brushes are shifted from their position of maximum effect. An admirable explanation of this subject will be found in Prof. Silvanus P. Thompson's "Dynamo Electric Machinery," 3d Edit., p. 64 et seq.—EDS. E. E.]

CHARGING STORAGE BATTERIES FROM ALTERNATORS.

[149.]—Will you please answer the following in your esteemed journal: What would be the result of using an alternating dynamo in combination with a storage battery?

R. C.

Annapolis, Md.

[Under the ordinary conditions, with the positive and negative impulses of the alternator of equal strength, the effect upon the storage battery would be nil. Several methods have, however, been devised so as to permit of the employment of alternating currents for the purpose described, in which the positive and negative impulses are differentiated with respect to the battery, so that impulses of only one sign act upon it. Mr. Tesla, among others, has invented and patented a number of such methods.—EDS. E. E.]

TELEPHONIC IMPROVEMENTS AT CINCINNATI.

Owing to the growth of the Walnut Hills district, the Cincinnati telephone people have found it necessary to make a change in the location of their branch offices, and the old Broadway exchange has now been removed to McMillan street, Walnut Hills. The work has been carried out under the active direction of Capt. G. N. Stone, the general manager of the company. A building has been constructed with a special view to exchange uses, and the operating room is on the second floor. It is finished in mahogany and is equipped with an improved multiple board, of the Western Electric Co.'s make. Besides the operating room, a sitting room is provided for the operators when on relief, and is comfortably furnished. The building has electric light and gas and steam heating. The cost of the whole is about $50,000, about half of which went for the new switchboard and its accessories. The change from the old office to the new was made in 26 seconds, 500 wires being switched.

EUROPEAN CORRESPONDENCE.

LONDON

The First Plant of the St. Pancras Vestry.—Report of the Metropolitan Electric Supply Co.

THE foundation stone of the Stanhope street station, the first of the St. Pancras vestry, has been laid. The plant will be capable of supplying low tension current to serve 10,000 incandescent lamps of 16 c. p. simultaneously, and at the same time high tension current will be provided on a separate set of mains to serve public lights in the streets, to the extent of 90 ten-ampere arc lights, or a larger number of lamps of equivalent candle-power at the outset.

There will be nine low tension, and two high tension dynamos, one of each sort serving as a standby or reserve. All the dynamos will be driven direct by triple expansion condensing engines. There will be six sets of batteries or accumulators (capable of serving 800 or 900 lights) to work all the lights in use at periods of minimum demand when the engines and dynamos would not be working and they will further act as an additional standby or reserve.

Provision is made at the outset for 5 miles of distributing mains which are designed to carry current for 25,000 incandescent lamps of 16 c. p. in use simultaneously, and separate mains are provided for the public street lighting.

The St. Pancras parish now remains intact in the hands of the vestry for the purpose of distributing electrical energy under a provisional order obtained in 1883. No company has as yet succeeded in obtaining powers within the area.

The report of the Metropolitan Electric Supply Co. states that while it is impossible until the accounts have been audited, to review the financial position in detail, the directors are of opinion that the prospects of the undertaking are such as to warrant them in looking forward to a satisfactory dividend being earned in the ensuing year. During the fourteen months which have elapsed since the company obtained Parliamentary powers upwards of forty miles of electric light mains have been laid in pipes under the streets of the principal thoroughfares of the company's districts. Current is at present supplied from four central stations.

H. S.

LONDON, Nov. 8, 1890.

Electric Light in Chagford.—Underground Circuits in Berlin and Vienna.—Traction in France.—A Controversy at Leamington.—Electric Light in Belgium.—Electrical Trades Section and Overhead Wires.—Metropolitan Electric Supply Company.—Institution of Electrical Engineers.—The Channel Telephone.—Halifax and Bermuda Cable.—Central Stations in Germany.—Telephones in France.—Train Lighting in Hungary.

ANOTHER illustration of the spirit of progress shown in small villages comes from a place named Chagford. Here a millwright and machinist has taken an old mill which has been uninhabited for several years and intends to supply the inhabitants with electric light. Power will be obtained from a large water wheel. Dynamos are installed, and already current is being supplied.

The results obtained with the underground telephone circuits in Berlin have been so successful that the Imperial Post Office is making further experiments. Telephone cables are now laid between Berlin and Küstrin, and Berlin and Hamburg. I hear that experiments have been made in this direction by the Vienna Postal authorities.

The action taken about a year ago by the French Electrical Accumulator Co. of placing several accumulator cars on the Levallois and Madeleine line has been followed up by another company. Cars worked by storage batteries are to run between the Palais de l'Industrie and the Place de la Concorde.

A controversy likely to be carried on by the lawyers has arisen between Messrs. Chamberlain and Hookham, electrical engineers, and the Leamington Corporation. It is said that the light supplied by the firm is below the standard, and on those grounds payment is refused. On the other hand, the contractors consider the tests unfairly carried out. They will ask the Board of Trade for a provisional order enabling them to supply the whole of the borough with electric light. This is a most doubtful policy. Many of the companies here apply for powers, forgetting that before they are granted the consent of the local authorities must be obtained. Failing to gain the permission, they sacrifice half the deposited sum, which is by no means an inconsiderable amount.

The Belgian town of Ninone, situated about fifteen miles to the westward of Brussels, is the first town in that country to adopt the electric light. It is a curious fact that this place was the first to adopt gas. The concession granted to the gas company expired on the 30th of September last, and the municipality having decided to abandon gas, have entered into a contract with an electric light company of Brussels to supply light for thirty years. The lighting is to include streets, squares and public places, as well as private dwellings. The installation comprises

two large boilers, two Ridder engines of 20 h. p. each, two Siemens dynamos of 16,000 watts and two batteries of Tudor accumulators capable of feeding 600 lamps for six hours. The distribution is effected by means of overhead wires. The old gas lamp fixtures will be used. The cost will be rather less than that charged for gas.

A meeting of the members of the Electrical Trades Section of the London Chamber of Commerce took place on Monday. Mr. Crompton, in his capacity of chairman, spoke with considerable emphasis on the subject of the Board of Trade Rules relating to overhead wires. Two most important rules have been embodied, which, if persisted in, will preclude the possibility of the extension of electric lighting in town. The first of these rules says that every wire whatever its thickness shall have a rubber coating of the thickness of one-tenth of an inch, and on the top of this there shall be the usual braiding or tape. The Silvertown India Rubber Company state that the cost of a wire insulated in the prescribed manner would be £80. The cost of the wire which this same company guaranteed to be absolutely safe is £28. This being the case, it is natural to suppose that firms who had overhead wires erected before the advent of the rules feel vexed. In the case of Messrs. Crompton, an installation at Chelmsford, having thirty-nine miles of conductors, is, as the rules stand, illegal. The Brush Company, the English representatives of the Thomson-Houston system, have also overhead wires which are affected in the same way. Another rule makes the use of suspenders necessary, although it is held by contractors that they answer no useful purpose whatever.

It was finally decided by the Chamber of Commerce that further pressure should be brought to bear on the officials of the Board of Trade, and in the event of this not having effect the question will be brought forward in the House of Commons.

I gave a few particulars in my last letter about the Metropolitan Electric Supply Company culled from their annual report. At the meeting held last Friday the chairman, Sir John Pender, made some very interesting remarks. At the previous meeting held six months ago they were supplying current to 15,000 lights consumed by 58 customers. Now, they supplied 40,000 lights to 300 customers, a far larger number than was supplied by any other company in the United Kingdom. They had contracts in hand for 10,000 more and applications were made every day. The area in which this company works has on its surface the principal theatres, and everyone takes a heavy supply of current. Testimonials were read from the managers of these places and all expressed the utmost satisfaction with the light. The following table of this year shows a great increase. In March they had 16,000 lights, April, 19,000; May, 21,000; June, 22,000; July, 23,000; August, 30,000; September, 33,000; October, 36,000; November, 40,000. The detail work showed the same satisfactory state, and though the company do not declare a dividend it is said they have made £10,000 during the past six months. The doings of this company I may add are watched with great interest over here.

The annual dinner and soiree of the Institution of Electrical Engineers will be held next week. Among those expected to be present are the Postmaster-General, Attorney-General, the Presidents of the Royal Society, Chemical Society, and the Institution of Mechanical Engineers.

The French section of the telephone line and cable, which is to connect London with Paris, has been completed. It consists of two bronze wires parallel, and crossed at intervals to diminish the effects of induction. There will be direct telephone communication between London and Marseilles, and London and Rome.

The daily journals here announce that the Halifax and Bermudas Company's cable has been duly tested and a certificate granted by the government.

According to statistics there are twenty-one central electric lighting stations in Germany. The horse-power employed is 20,975.

The management of the Royal Hungarian State Railway has resolved to introduce the electric light in their trains. H. S.

LONDON, Nov. 12th, 1890.

INSPECTION INVITED OF THE NEW YORK TELEPHONE EXCHANGE.

So far from holding its patrons at a distance, the Metropolitan Telephone and Telegraph Co. invites them to learn for themselves how the work is done, so that with fuller knowledge there shall be an appreciation of the efforts made to maintain every department at the highest efficiency. Mr. David B. Parker, the general manager, has issued the following pleasant circular :

You are cordially invited to visit, at your convenience, our Exchange at 18 Cortlandt street. We think you would be interested in witnessing the practical working of the telephone system in our operating room, where the largest and most expensive switch-board ever constructed is in use, and we believe the visit would result in mutual advantage in our relations. An exchange of suggestions as to use of the telephone, between officials of the company who are devoted to the subject in hand, and subscribers who are relying upon the telephone system as an important business necessity or social convenience may contribute toward improvement in service.

CORRESPONDENCE.

CHICAGO.

The Forsyth Electric Elevated Road.—Electric Light Consolidation in Milwaukee.—The Love Electric Traction Co.

A NEW system for elevated roads to be operated by electricity has recently been devised by R. C. Forsyth and a company has been organized to build a line from East Chicago and Hammond through the Calumet district, to connect with the down-town cable lines and use this system. A working model has been completed and is to be seen in operation in one of the rooms of the Rookery. It is proposed to obviate the objectionable features of the present systems of elevated roads by doing away with the heavy upright posts and overhanging structure. At each street corner a steel tower is erected, about 45 feet high, having four spreading columns, or legs, after the manner of the Eiffel tower. The four columns spring from the corner curbs and form a double arch over the street corner. Over these towers, a three and a half inch steel wire cable extends, forming the roadway foundation. Beneath this cable and connected to it by ties are two longitudinal iron beams which are the basis of the track. The tracks are covered by common railroad rails which are 16 inches apart. The ties and struts are so arranged that the structure is rigid and the track maintained at a uniform level. The car is of the size of a regular street car, but with the wheels upon the roof instead of under the floor. The gears of the cars are two inverted trucks of four wheels each which extend above and rest on the rails, and the arrangement of the trucks is such that in the case of a broken wheel or axle the car cannot leave the track. The wire carrying the current instead of being exposed to the weather is covered and placed between and under the tracks. The trolley wheel follows this wire and the connection is free from sleet or snow in bad weather. The stations for receiving passengers will be elevated to the level of the car and it it is claimed that by the new system the advantages gained are numerous.

Since the purchase of a controlling interest in the Edison Incandescent Light and Badger Electric Light plants in Milwaukee by the Villard syndicate, an effort has been made to secure an amended franchise from the Common Council allowing the consolidation of the two companies under one management. This has been obstinately opposed by some of the aldermen on the ground of creating a monopoly. After a long fight in the Council the amended ordinance has been ordered to a third reading, the company agreeing to furnish free to the city the electric power to operate ten of the down-town bridges thereby making a saving to the city annually of $10,000.

The Love Electric Traction Company is a new concern organized with the object of changing street car lines now being run by horse or other power into an electrical underground system. The method to be employed is a new conduit of peculiar construction made without bolts or screws and so fastened together that it can be readily taken apart to get at the wires within. A slot is used in the conduit similar to that in the cable lines and the first electrical street railway conduits built. The incorporators are Judge H. N. Hibbard, J. C. Love, and A. G. Wheeler, with a capital stock of $10,000,000. It is proposed to thoroughly test the system and erect car shops in the neighborhood of Chicago, and manufacture not only their own cars, but all the other adjuncts of the system. It is expected that cars will be in operation in the early spring.

CHICAGO, Nov. 27, 1890.

PITTSBURGH.

McKeesport Electric Railway.—The Central Electric Railway, of Beaver Falls.—A New Electric Line to Homestead.—How Electricity Has Resuscitated a Horse Road.

THE McKeesport Electric Railway Company and the Baltimore and Ohio Railway Company are indulging in a little controversy just now. All the trouble has been caused by a crossing on Main street, McKeesport. The electric railway company's line, which runs along Main street, has to traverse the B. & O. tracks on this thoroughfare, and the street railway management proposes to pave the crossing with block stone, while the railroad people desire to use plank on the crossing. Until both corporations come to an agreement on this point the electric railway company will not be able to run across the B. & O. tracks. The electric railway line is otherwise nearly completed, it requiring only the putting up of the pole line to finish the construction of the line.

The Central Electric Street Railway Company, of Beaver Falls, intends to run an electric road from Rochester to Beaver and Beaver Falls, a distance of about eight miles. At West Bridgewater a branch will extend to Rochester, across the big Beaver bridge, the Rochester end of which will be raised 20 feet, thus reducing the grade into the latter place. The work of raising the

bridge will be done by the Pennsylvania Company, which contemplates changing the grade at this place. The capital stock of the company is $60,000, and the corporation is headed by the most prominent business men of Beaver Falls. Rights of way have been granted the company in nearly all the towns in the Beaver valley.

An ordinance has been granted the Duquesne Traction Company, of this city, giving that corporation the privilege of using the tracks of the Market and those of the Grant Street Electric Railway Company as well as the tracks of the Central Passenger Railway Company. These roads will form the loop in the downtown portion of the Duquesne Traction Company's system.

The Second Avenue Electric Street Railway Company commenced a few days ago to extend the tracks of its line from the Glenwood terminus in this city towards Homestead. The latter place is a suburb of Pittsburgh, about eight miles from this city. To build an electric road to that town is connected with a good deal of expenses, it requiring the erection of a bridge across the Monongahela river. This, however, is not going to deter the promoters of the new enterprise, because they feel confident that the road will be a success from the very start. The accessibility of Pittsburgh from Homestead is at present very defective, but the proposed electric street railway will form a straight line of communication from one to the other. The company intends to have new double truck cars built for the new road, and it has been decided to run the cars at a speed by which the passengers will be taken from Pittsburgh to Homestead in 45 minutes. The management of the Second Avenue Electric road promise to have the entire road in operation by next fall.

The Second Avenue Electric road has been one of the most successful street car lines in this city since it changed its motive power from horses to electricity. The road began to run the electric cars last April. Before that it was considered one of the worst street car lines in the city, in fact nobody would patronize the company's line unless compelled to. Of course the result was that the stockholders never received any dividends on their investment, which certainly prevented them from putting any more cash into it than they could help. Since the motive power has been changed, however, the property has considerably increased in value. The stock is now quoted on the local stock exchange above par, and the fact that the management has decided to incur the expense of extending the line to Homestead proves that they must have made money. This is another evidence that where a horse car road may be a failure an electric road can be a great success.

PITTSBURGH, Nov. 14, 1890.

BOSTON.

Mr. B. S. Flanders Appointed Inspector of Wires—West End Railway Work.

AT a meeting of the board of aldermen held this week, on motion of Alderman Folsom, the confirmation of the appointment of Brown S. Flanders to be an inspector of wires under the statute and ordinance recently passed, was carried unanimously.

So great has become the immediate necessity for more power for the electric system of the West End Street Railway Company that they have ordered three more McIntosh and Seymour engines and twelve 80 horse-power Thomson-Houston generators, to be installed temporarily in the permanent boiler house of the new power station on Harrison avenue. Work is now begun on the erection of the permanent boilers, but sufficient room will be left on one side of the boiler house for the temporary reception of these engines and generators. Steam will be furnished by the permanent boilers, and the new smokestack which is all but completed will be used. It is now an assured thing that Boston will have an electric elevated road, whichever actual route may be adopted, and the plans for the construction of the road are now being made. When this project actually takes shape, there will be a necessity for about 25,000 more horse-power, and the West End Company are now giving this matter their careful consideration.

BOSTON, Nov. 29, 1890.

FRANCISCO'S "MUNICIPAL LIGHTING."

The National Electric Light Association has now issued, as voted by the members at Cape May, the paper read there by Mr. M. J. Francisco, on "Municipal Lighting." As a supplement to the paper, which has attracted a large amount of attention, is printed correspondence with Prof. J. B. Barrett, of Chicago, as to the failure of the latter to take up and answer the statements of Mr. Francisco relative to Chicago city lighting, as he had promised. Prof. Barrett, on his part, complains, it appears, of bad faith on the part of the Association in letting the Francisco paper go out broadcast, before-hand, without waiting for his statement. He says he is still ready to prepare the report on Chicago work if it is wanted.

SOCIETY AND CLUB NOTES.

BALL OF THE CITIZENS' CO., BROOKLYN.

The Aid and Benefit Association of the Citizens' Electric Illuminating Co., of Brooklyn, will give its fourth annual ball, on December 5. J. Supple is president of the association; E. Reynolds, secretary; B. F. Rush, vice-president and J. R. Barefield, treasurer; E. F. Peck and L. Duncan are trustees, and J. Duncan is chairman of the executive committee. The ball committee are T. Duffy, G. Hughes and A. J. Moran.

VISIT OF THE NEW YORK ELECTRICAL SOCIETY TO AN EDISON STATION.

On Tuesday evening, November 25, the New York Electrical Society made a visit of inspection to the fine Twenty-sixth street station of the Edison Electric Illuminating Co. They mustered in good number and were received by Mr. R. R. Bowker, vice-president of the company, who made an interesting address of welcome detailing the work of the company, the scope of its service and supply, and touching upon various points of station equipment. Mr. John Van Vleck, the chief electrician of the company, with others of the staff then took the visitors in hand, and starting from the top of the building escorted them in parties through every floor, explaining all the special features of interest in each department. This occupied some time, as an opportunity of such a kind is rarely afforded. When the visitors reassembled on the dynamo floor, they were given an excellent collation, the hospitality of the company being in this respect, as otherwise, of the most cordial and profuse nature throughout the evening. Due acknowledgments were tendered to President Spencer Trask and his associates, by Prof. F. B. Crocker, Mr. C. O. Mailloux and Dr. Otto A. Moses, in the name of the society, as its officers, for the kindness and attention shown the members.

DINNER AT THE NEW YORK ELECTRIC CLUB.

A dinner will be given at The Electric Club, Thursday evening, December 4th, costing $2.00 per plate, exclusive of wines. Each member is entitled to bring one guest, and notice must positively reach the club not later than Wednesday morning, December 3d. There will be after-dinner speeches, and music, etc., provided by the committee on entertainment. It is the intention of the committee to have these social occasions alternate with the regular monthly lectures of the club, which occur every third Thursday

ELECTRICAL DEPARTMENT, BROOKLYN INSTITUTE.

On Friday, December 5th, at 8 P. M., a lecture will be delivered in the lecture room of the Y. M. C. A. building, by Mr. Ralph W. Pope, secretary of the American Institute of Electrical Engineers, on "Electrical Engineering: Its History and Possibilities." The lecture will be interesting and is likely to attract a large audience.

COLLEGE NOTES.

NOTES ON ELECTRICAL ENGINEERING DEPARTMENT AT CORNELL UNIVERSITY.

At the meeting of the Electrical Association on the 10th Nov., Instructor Saunders gave his method of determining the direction in which lines of force circulate about a wire in which a current is flowing, the basis of his method being the assigning to the line of force the quality of elasticity.

On the 17th, Mr. Lindsay, '91, described the Wenstrom dynamo, a very remarkable feature of this dynamo being the low speed of 300 to 400 revolutions at which it is run.

A new belt-testing apparatus has been added to the equipment of Sibley College through the kindness of Wm. Sellers & Co. The principal feature of this apparatus is a costly dynamometer that is peculiarly adapted to practical belt-testing, and is a most valuable acquisition for the college.

Herschel, '90, is in the employ of the Thomson-Houston Co., at Boston, as draughtsman. R. G. Thompson is making an investigation of the Thomson-Houston arc machine, similar to the one made of the Stanley dynamo by Tobey and Wallbridge last year.

NASHUA, N. H.—The first electric car ever run in this city began its trips on November 21st at the yard of the Nashua Manufacturing Company. It is a broad gauge track, used to carry the finished cloth from the cloth room to the storehouse. When the road is completed it will be about half a mile long and comprise both narrow and standard gauge tracks.

REPORTS OF COMPANIES.

FORT WAYNE ELECTRIC CO.

The treasurer of the Fort Wayne Electric Co. makes the following report to stockholders of business for the six months ending Aug. 31, 1890: Sales after deducting commissions, $867,545; net profits, $161,207; surplus March 1, $172,334; total, $333,541; dividends May 15, $90,000; present surplus, $243,541. The net profit for the past six months has been over 4 per cent. on present capital of $4,000,000. By careful estimate of the value of assets the face value has been reduced more than $300,000. The increase in the number of local companies using the Fort Wayne system during the past six months was 24, making the total number at present 128. The manufacture of dynamos and lamps will hereafter be conducted at the new factory at Fort Wayne instead of at Brooklyn, N. Y., thus effecting a large saving in cost.

AMERICAN BELL AND WESTERN UNION.

The Boston *News Bureau* says:—The attacks on Western Union and the strength of the Bell Telephone are calling attention to the relations between these two properties, and we are asked the date of the expiration of the famous telephone contract, under which the Western Union sold the Edison and all its telephone patents and claims to the Bell Telephone Co. for 20 per cent. of the Bell Co.'s telephone rentals. From this source the Western Union Telegraph Co. has now an annual net income of over $500,000. This contract was made Nov. 10, 1879, as for Nov. 1. It is for 17 years, in order to cover the lives of all the then existing patents, and will expire Nov. 1, 1896. At that date there need be no quarrel, as there will be practically no instrument rental to quarrel about. The Bell Telephone Co. will then derive its income from the Long Distance Telephone Co. and from its stocks in local telephone companies, majority control of nearly all of which it now has. The Western Union, however, is a considerable stockholder in the Metropolitan or New York Co. With the Bell Telephone Co. controlling the copper wire service of the country, telephone competition will prove more futile than have the attempts to duplicate the service of the Westean Union in the telegraph field. The Bell Telephone patent first issued expires March 7, 1893. The second Bell patent, covering the magneto field, will expire Jan. 30, 1894. The serious phase of the Western Union-Bell relations lies in the fact that the Bell Telephone Co. is building a self-supporting long-distance telephone system through the country, which will give it the most perfect telegraph system, at absolutely no additional cost for construction or maintanence, except the few dollars required for telegraph keys and sounders on the telephone desks. It has been demonstrated to the satisfaction of the Bell people that a telegraph business can be done upon the telephone lines perfectly and without any interference or disturbance of the telephone business upon the same lines at the same time. The telephone circuit, which now requires two copper wires for speech between cities, will furnish two distinct telegraph wires for four Morse operators working at the same time.

A RECONSOLIDATION OF THE RICHMOND COMPANIES.

The two passenger railways and the three electric light and power companies of Richmond, Va., have formed a consolidation under the new name of the Richmond Railway and Electric Company. The deeds of sale were recorded and a mortgage of $7,000,000 to the Atlantic Trust Company was executed. The companies going into the combination are the Union Passenger Railway Company, the City Railway Company, the Virginia Electric Light and Power Company, the Old Dominion Electric Light and Power Company, and the Richmond-Schuyler Electric Light and Power Company. The new concern holds all properties of the original companies and assumes all indebtedness. The mortgage given the Atlantic Trust Company secures 2,000 $1,000 gold bonds, running thirty years at five per cent. The money thus raised is to pay off a small indebtedness and improve the various plants and replace railway tracks and rolling stock.

STOCKS AND BONDS.

THE SPANISH-AMERICAN LIGHT AND POWER COMPANY, consolidated, of New York, has filed a certificate at Albany that its capital has been increased from $3,000,000 to $4,000,000. The record also states that the entire capital of $3,000,000 was issued in payment for property necessary for the business of the company and that the existing debts are $980,879.45.

THE BELDING MOTOR AND M'F'G CO., of Chicago, has filed a certificate of increase of capital stock from $1,000,000 to $2,000,000.

LEGAL NOTES.

THE PROPOSED MUNICIPAL PLANT FOR PEABODY, MASS.

The supreme judicial court heard evidence recently at Salem, on the petition to enjoin Peabody from spending money on an electric light plant. The questions raised were: 1. Whether a town may without special legislative authority incur a large expenditure for the erection and maintenance of an electric light plant for the purpose of lighting its streets. 2. Whether, if a town may lawfully do this, it may incur a larger expenditure than would be necessary for such purposes with a view of selling electric light for commercial purposes to the public generally. The defendant town introduced evidence tending to show that the committee did not propose to do more than to provide a plant for street lighting purposes, but as it is clear that the validity of the action of the town is to be determined by the terms of the vote and not by the subsequent action or the present intention of the committee, the petitioners propose to disregard this evidence altogether.

The public statutes do not authorize a town to maintain an electric light plant for the purpose of lighting its streets. In order for towns to establish water systems they have to get legislative permission. If a town can establish an electric light plant and manufacture electric light, it could have and can now establish a gas plant. Prior to this proposed action no town has undertaken to establish either a gas or electric plant. It is despotically taking the control of capital from its owners and transferring it to others. If they can embark in manufacturing, why not in mercantile pursuits of any and every description. In the case at bar the vote of the town plainly contemplated the erection of a plant for commercial purposes as well as for public purposes.

It is alleged that there is not any intention of using the plant for the purpose of supplying surplus lighting power to private persons, and that there is not likely to be any surplus power which can disposed of. It has already been determined that the constitution permits towns to appropriate money to establish and maintain a plant for lighting the streets by electricity. If it has such power, its means to be adopted are entirely within the power of the town to determine. The defendants contend that the town has power to light its streets by express statute provision and by usage.

SUIT AS TO USE OF THE WORDS "ELECTRICAL SUPPLY."

Recently suit was commenced in the United States Court against the Great Western Electric Supply Co., of Chicago, by the Electrical Supply Co., of the same city, the latter company wishing to establish their exclusive right to the use of all parts of their firm name. They were the first to adopt the name "Electrical Supply," but during recent years many other companies have taken practically the same name and there has resulted a confusion, which, it is claimed, is detrimental to The Electrical Supply Co. This company intend also to bring suit against other companies using the words "Electrical Supply," and hope to establish a precedent through the courts as to their titular rights.

NEW ENGLAND SHOE AND LEATHER ASSOCIATION vs. EDISON ILLUMINATING CO., OF BOSTON.—COMPULSORY SERVICE.

The State Board of Massachusetts Electric Light Commissioners has rendered a decision in the case of the New England Shoe and Leather Association and others against the Edison Illuminating Company, which is important both in itself and as a precedent. The Shoe and Leather buildings on Bedford and Kingston streets each contain steam power and an electric light plant with incandescent lamps. The petitioners desire the current from the Edison wires when the dynamos in the building are not running, and especially after six o'clock in the evening. The Edison Company objected to supplying the current, chiefly on the ground that the buildings are not furnished with Edison lamps. It put in evidence a contract dated Jan. 26, 1886, with the parent Edison Company, whereby, as it claims, it agreed not to use or supply current for any but Edison lamps.

The commission holds, however, that the provision in the United States Constitution prohibiting a State from passing any law "impairing the obligation of contracts" does not diminish the police powers of the Legislature, and, therefore, that a company chartered for the express object of selling light and electricity, and given the privilege of occupying the highways with its wires and structures, should be under obligation to furnish the same when it can conveniently be done.

AYER, MASS.—The Ayer Electric Light Co., Dr. B. H. Hartwell, president, intend taking immediate steps toward putting in a system to comprise Ayer, Shirley and Groton. The Groton Episcopal School will also be supplied.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED NOV. 25, 1890.

Alarms and Signals ;—

Elevator Signaling Apparatus, R. P. Garsed, 441,150. Filed May 6, 1890.

An annunciator in elevator, a series of flexible conductors from the annunciator to a fastening point in the wall of the shaft, and from thence to actuating devices upon the several floors, a supporting bracket having a flange with poles for attachment thereon, and a flared and channeled part or parts for holding the conductors in place.

Electrical Call, Lighting and Alarm System, C. A. Hale, 441,157. Filed Dec. 28, 1889.

A system of circuits, switches, annunciators and bells, especially designed for hotels, whereby the following results may be effected: A call by a guest in any room to the office; a call to any room or to all the rooms from the office; automatically sending a call to any room, or any number of rooms, at any given time; sending a call to any room or any number of rooms from the office at will and simultaneously lighting the gas or electric lights in such room or rooms; automatically calling one or more rooms and lighting the gas or electric light therein at any given time; sounding an alarm on one or more floors simultaneously and automatically turning on the light on such floors on which the alarm is sounded.

Annunciator, C. W. Holtzer, 441,304. Filed Aug. 19, 1890.

Details of construction of the frame work for supporting the magnet and armature and the drop in the proper relations to one another, and to secure certainty of operation.

Distribution :—

Device for Transforming and Controlling Electric Currents, O. A. Enholm, 441,542. Filed Feb. 20, 1890.

Obviates the excessive sparking and formation of arcs encountered in transformer systems when a pulsatory or intermittent current is employed by causing the primary circuit to be interrupted in a vacuum between solid conducting electrodes.

Dynamos and Motors :—

Armature-Body, C. A. Lieb, 441,246. Filed Sep. 18, 1890.

A series of discs of iron and insulating material, a tube through the centre of them, the ends of which are turned over or expanded against the outer discs, and stay rods longitudinally between the tube and the periphery of the disc, the ends of which are also turned over against the outer disc.

Dynamo-Brush Clamp, T. Reese, Jr., 441,256. Filed July 22, 1890.

A frame adapted to pass over and clamp the end of a brush near to the end in contact with the commutator; and particularly adapted to brushes made of several sections.

Method of Winding Dynamo-Armatures, C. E. L. Brown, 441,391. Filed Feb. 5, 1890.

Claim follows: The method of winding dynamo-armatures, consisting in winding one layer of wires upon the drum, placing a suitable continuous insulation upon said layer of wires, and then winding a second layer of wires upon the insulation, substantially as set forth.

Wire Joint for Commutators, W. E. Harrington, 441,487. Filed Aug. 28, 1890.

The commutator plate is provided with a longitudinal orifice to receive the wires which are first covered with a sleeve adapted to fit the orifice snugly; the wires are then secured in position by screws or other mechanical means. The two wires are sharply twisted upon each other after insertion into the sleeve and before insertion into the commutator.

Galvanic and Thermo Electric Batteries :—

Electric Battery Connections, H. J. Brewer, 441,130. Filed Sep. 5, 1890.

Second claim as follows: In an electric battery, the combination, with a carbon element, of a zinc connection and a metal arranged intermediate of the zinc connection and the carbon element, and of such character that it will not produce any appreciable galvanic action in connection with the carbon element, substantially as specified.

Galvanic Battery, O. A. Enholm, 441,408. Filed April 21, 1890.

A cell with an internal cup forming two compartments with a removable frame supported by the cup and insulated from it, the frame supporting both the positive and negative electrodes, one of which is insulated from the frame.

Lamps and Appurtenances :

Manufacture of Incandescent Electric Lamps, A. Bornholdt, 441,127. Filed Mar. 19, 1890.

Process of creating a vacuum with the aid of a multiple stopper—one stopper inside the other—the process consisting in first holding the vessel in inverted position allowing the auxiliary stopper to drop open, then applying the vacuum process, then reversing the vessel and causing the auxiliary stopper to close the passage and sealing the vessel.

Incandescent Electric Lamp, A. Bornholdt, 441,128. Filed Mar. 19, 1890.

Amplification of the above.

Means for Hanging Electric Lights, T. J. Lynch, 441,248. Filed Dec. 18, 1889.

An independent hook rigidly attached to the frame work of the lamp, the end of the hook being adapted to ride up over and grip the suspension cord or cable when the lamp is raised.

Arc Lamp, O. A. Enholm, 441,543. Filed Feb. 20, 1890.

Claim 1 follows: In an arc lamp, the combination of the regulator-rollers mounted on resilient supports and provided with breaking-rollers, and a carbon-holder arranged to operate in connection therewith, substantially as and for the purposes set forth.

Measurement :—

Pyrometer, W. S. Hensley and W. H. Grindley, 441,488. Filed April 28, 1889.

Claim 1 follows:

In an electric heat-measuring device, a resistance device consisting of an earthenware core upon which is wound a coil of wire and a covering of earthenware or like fire-resisting material through which the terminals or leads of the wire coil pass, in combination with a Wheatstone bridge with which the terminals of the said coil are connected, substantially as described.

Metal Working :—

Method of Electric Welding and Metal Working, M. W. Dewey, 414,401 Filed Sept. 5, 1890.

Consists in connecting the bar or blank with one terminal of an electric generator, embedding the part of the bar or blank to be worked in a yielding bed of conducting material connected with the other terminal of the electric generator, and passing a suitable heating current through the bar or blank also includes the magnetization of the bar or blank while under operation.

Miscellaneous :—

Flash-Light Photographic Apparatus, W. H. Harbeck, 441,158. Filed Apr 30, 1890.

First claim follows: In a photographic flash-light apparatus, a friction-plate, match, and match-holder, in combination with an electric circuit and magnet adapted to control such match and friction-plate, substantially as shown and described, for the purpose specified.

Rheostat, J. Doyle, 441,298. Filed Aug. 1, 1889.

Claim 1 follows: A rheostat or resistance formed of a cylinder of earthenware, having a grooved surface and resisting material in such grooves and connections for the electric conductors, substantially as specified.

Automatic Electric Gas-Lighter, L. R. S. White, 441,458. Filed May 23 1890.

For turning on and off a gas jet and when turning it on to light it.

Apparatus for and Method of Registering and Indicating the Course and Position of Marine Vessels, J. O'Neil, 441,579. Filed July 23, 1890.

Mechanical and electro-magnetic devices controlled by a revolving wheel carried upon a ship's log, whereby the position of the ship may be indicated upon a terrestrial globe on board.

Electrical Switch, G. Schultz, 441,588. Filed July 29, 1890.

A hand switch, specially applicable for use in circuits of high potential; a wide distance is provided between the contacts.

Coin-Operated Shooting Gallery, A. M. Coyle, 441,613. Filed Aug. 31, 1889.

Claim 8 follows:

The combination of the shooting device connected with its support by a universal joint, a target, an electric circuit, and a contact-maker adapted to close said circuit when the target is struck by a projectile from said shooting device, substantially as described.

Electrical Thermostat, C. H. Shaffer, 441,622. Filed May 9, 1890.

A thermostat on the open-circuit plan, held open by a link of fusible alloy; upon the melting of the link the circuit is closed.

Railways and Appliances :

Contact-Trolley for Electric Railways. N. C. Bassett, 441,122. Filed July 21, 1890.

Spring is so arranged and connected with the trolley that when the latter flies up to its highest position upon jumping the conductor it is automatically freed from the action of the spring.

Trolley for Electric Railway Cars, N. C. Bassett, 441,123. Filed July 26, 1890.

Similar to above; when the trolley jumps the wire the operating spring is automatically relieved of its tension.

Electric Street Railway System, M. Wheless, 441,210. Filed March 15, 1890.

Claim as follows:

The combination of a continuous power-line, a trolley-line composed of sections insulated from one another, a car having thereon a motor-circuit in electrical connection with the trolley-line, a local circuit, part of which containing the source of electricity is on the car, and a switch between the local and the trolley-line and power-line, whereby when the local is closed a section of the trolley-line is connected to the power-line, as set forth.

Electric Street Railway System, M. Wheless, 441,211. Filed May 3, 1890.

Amplification of the above; addition of a contact-preserver between the power-line and the trolley-line section, which maintains the contact after the local makes it and until the car leaves the section of the working conductor; also claims a continuous *insulated* power-line conductor and an uncovered working conductor in sections, insulated from one another, in combination with the other features.

Conduit for Electric Railways, M. Wheless, 441,212. Filed May 12, 1890.

Claim 4 follows:

A conduit for underground electric railway systems, consisting of brackets made with cable-standards and spaced apart, the walls of the conduit running from bracket to bracket and spaced apart at the top, cover-plates spaced apart and covering the space between the top of the conduit-walls, one of said cover-plates being permanently and the other removably secured to the brackets, as set forth.

Auxiliary Contact for Electric Railways, M. Wheless, 441,213. Filed July 14, 1890.

Claim 1 follows:

The combination of a car having insulated wheels to which circuit-wires are connected, and the line of rails with an auxiliary contact located between the wheels and the rails, as set forth.

Electric Railway Cut-Out, M. Wheless, 441,214. Filed July 21, 1890.

Electro-magnetic cut-out placed upon car for breaking a local circuit automatically when the power-line has been connected to a section of trolley line.

Insulated Brake, M. Wheless, 441,215. Filed July 21, 1890.

Claim 1 is as follows:

A railway-car brake in combination with the brake beam, the rubbing part of the brake being electrically insulated from the beam, as set forth.

Electric Railway System, M. Wheless, 441,216. Filed July 21, 1890.

Arrangement of the magneto-electric device for connecting the power-line with the working conductor sections so as to make a sufficiently wide break when the working conductor section is cut out.

Electric Railway System, M. Wheless, 441,217. Filed Aug. 27, 1890.

The claim follows:

In an electric railway system in which a local circuit operates an electro-magnetic switch in the main circuit, such local circuit having a break, in combination with a switch lever at such break, provided with a spring which normally holds the lever in the break and the rheostat in the main circuit, the lever of which crosses the switch-lever, and thereby moves the switch-lever against the spring, as set forth.

Electro-Magnetic Switch for Electric Railways, M. Wheless, 441,218. Filed Aug. 27, 1890.

Application of carbon contacts to terminals of electro-magnetic switch for connecting power-line with trolley-line sections.

Electric Railway System, M. Wheless, 441,219. Filed July 21, 1890.

Claim follows:

The combination of an insulated power-line, a bare working-conductor or motor trolley-line in insulated sections, a bare local-circuit trolley-line in insulated sections, a car provided with a motor and a battery, a trolley in electrical connection with the motor and the motor trolley-line, another trolley in electrical connection with the bat ery and the local circuit trolley-line, an electro-magnetic switch between the power-line and working-conductor, the local circuit being in electrical connection with the magnet of said switch, as set forth.

Trolley for Underground Electric Railways, S. E. Wheatley, 441,220. Filed July 21, 1890.

Trolley especially adapted to use where the working-conductor or trolley-line is in sections. Two concavo-convex brushes carried upon a yielding support and at a sufficient distance apart to insure contact with one or the other section at points of separation.

Conduit for Electric Railways, S. E. Wheatley, 441,221. Filed Aug. 28, 1890.

Claim 1 follows:

In an electric-railway system the working-conductor of which is underground, the combination of an open-slotted conduit supported upon brackets, a working-conductor in such conduit, supports for such conductor, and boxes separate and distinct from the brackets, and in which boxes the conductor-supports are secured, as set forth.

Telpherage System, J. E. Maynadier, 441,250. Filed Aug. 4, 1890.

An improvement in the system of passing the vehicle through electro-magnetic coils. The vehicle or carrier is compound, made up of a number of coils connected together by hollow couplings.

Conduit for Electric Railways, N. Seibert, 441,258. Filed March 5, 1890.

A supplemental frame hung from a railway truck and having supplemental wheels, a housing containing electric conductor, a rocking support having contacts adapted to be brought against the conductor.

Electrically-Propelled Vehicle, R. M. Hunter, 441,305. Filed Aug. 18, 1888.

Claim 1 as follows:

A car or vehicle having one or more compartments, in combination with two or more removable frames, each provided with a series of cells of battery and having two terminal contacts arranged in said compartments, hand-coupling devices movably secured within the apartments upon the car or vehicle for coupling up the terminals of the different series of cells of battery, a circuit on the car or vehicle including said battery-cells and hand-couplings, and a translating device in said circuit.

Suspending Device for Electric Wires, W. B. Marks, J. G. Lauer and R. R. Ralston, 441,312. Filed July 24, 1890.

An electrical conducting wire, a supporting wire above the conducting wire, and flexible suspenders between the posts upon which the supporting and conducting wires are sustained; the suspenders comprising an insulating portion having a transverse eye and a grooved periphery and being spaced at short intervals.

Method of Operating Electric Brakes for Electrically-Propelled Cars, W. M. Schlesinger, 441,330. Filed Jan. 28, 1888.

Consists of first cutting the car-motor out of the generator or supply current or circuit to convert said motor into a generator driven by the momentum of the car, and then successively using the armature current of the motor and the line or supply current to successively actuate said brake appliances.

Electrically-Propelled Vehicle, R. M. Hunter, 441,565. Filed Sept. 1, 1890.

Essential feature is the combination with a car and its axles of two electric motors, each of which is supported upon one side from a separate axle, the other side being supported by a yielding support connecting with a frame carried upon the axles independently of the vehicle body and arranged beneath the motors.

Electric Railway, H. W. Libbey, 441,571. Filed Sept. 23, 1889.

Claim 8 follows:

A conduit for electric railways, divided vertically into two parts, one part being slightly larger than the other and provided at its lower end with a recess forming a gutter, the two parts being each provided with a flange that are connected together by bolts, the inner surface of both sections being coated with an insulating material, in combination with two rails, one above the other, the lower rail being supported by chairs secured to the bottom of the conduit, and the upper rail by clamps that engage the upper end of the lower rail and the lower end of the upper rail, substantially as shown and described.

Electric Railway, H. W. Libbey, 441,572. Filed Oct. 9, 1889.

Consists in forming the rails hollow, covering the inner surface with insulating material, and suspending the electric conductor therein; also includes special devices for contacts between the motor and the conductor.

Secondary Batteries:—

Secondary Battery, G. E. Hatch, 441,413. Filed Feb. 13, 1890.

Object, to reduce the weight and consequent cost of lead plates as commonly employed. The invention consists in using stiff porous material, honeycombed or provided with holes, pits, grooves or depressions, both as separators and as supporters of the metal plate and in applying the active material to such porous plates instead of to the lead plates.

Telephones and Apparatus:—

Telephone, F. L. Capps, 441,396. Filed April 7, 1890.

A magneto receiver.

A permanent magnet with diaphragm mounted thereon, a vibrating armature between the poles of the magnet and connected with the diaphragm, and a stationary coil connected in the line circuit and surrounded the vibrating armature and having its axis longitudinal relatively to the armature.

FINANCIAL MARKET.

QUOTATIONS ON ELECTRICAL STOCKS.

F. Z. Maguire & Co., Electrical Securities, of 18 Wall street, this city, report the following quotations of November 29, from New York, Boston and Washington; Pittsburgh, November 28.

NEW YORK.

	BID.		BID.
W. U. Tel. Co	78¼	Edison Gen. Elec. Co	86¼
American Tele. & Cable	83	Edison Gen. Co. Def'd	....
Centl. & So. Amer	155	Consol'd Elec. Lt. Co	...
Mexican	210	Edison Ilin'g Co. N. Y	....
Com. Cable Co	100	U. S. Elec. Lt. Co.	30
Postal Tel. Cable	89	North Am. Phonograph	25

BOSTON.

	BID.		BID.
Thomson-Houston	44	Ft. Wayne Co	10¼
" Pref'd	25¾	Am. Bell	216
" Series C	....	Erie	47
" " D	5¼	New England	...
" Int. Co	....	Mexican	.75 cts
Thomson Welding Co	175	Trop. American	..
Thomson Eu. Welding	....	Edison Phon'gph Doll	1¼

WASHINGTON.

	BID.		BID.
Penna. Telephone	25	U. S. Elec. Lt (Wash.)	130
Ches. & Pot. Telephone	66	Eck.&Sold. Home Elec. Ry.	58¼
Amer. Graphophone	12¼	Georgetown & Tenallytown	49

PITTSBURGH.

	BID.
Westinghouse Electric and Manufacturing Co	24½

MR. CLARENCE E. STUMP.

There are very few people, indeed, in the electrical field in America to whom Mr. C. E. Stump is not known, and there are very few therefore who will not be interested to learn that he has become associated with the *Street Railway Journal*, of this city, and will enter upon active work as its vice-president and business manager at the beginning of 1891. That Mr. Stump should find it necessary after many years of faithful and brilliant performance of duty to quit the post he has so successfully held, must be a cause of regret and pain to his countless friends; but good work never dies, and he may rest assured that in his coming sphere of labor he will experience the reward and prosperity he has already so richly earned, though not enjoyed. Mr. Stump's selection of his new sphere is an evidence of the wisdom and judgment that, when he was free to exercise them, were the leading elements in the success of the institution he now separates himself from. The *Street Railway Journal* is a representative technical paper conducted with liberality and enterprise, and the management have the high esteem of all who know them. Among his new associates, Mr. Stump will find himself in congenial companionship, and our warmest, heartiest wishes are extended to them all.

MR. THOMAS FINNEGAN, for the last twenty years employed as doorkeeper of the operating department of the Western Union Telegraph Company in this city, died of typhoid fever last week, aged sixty-nine years. Every telegrapher in the country knew him and had a good story to tell about him. He had many eccentricities and a warm heart.

TRADE NOTES AND NOVELTIES

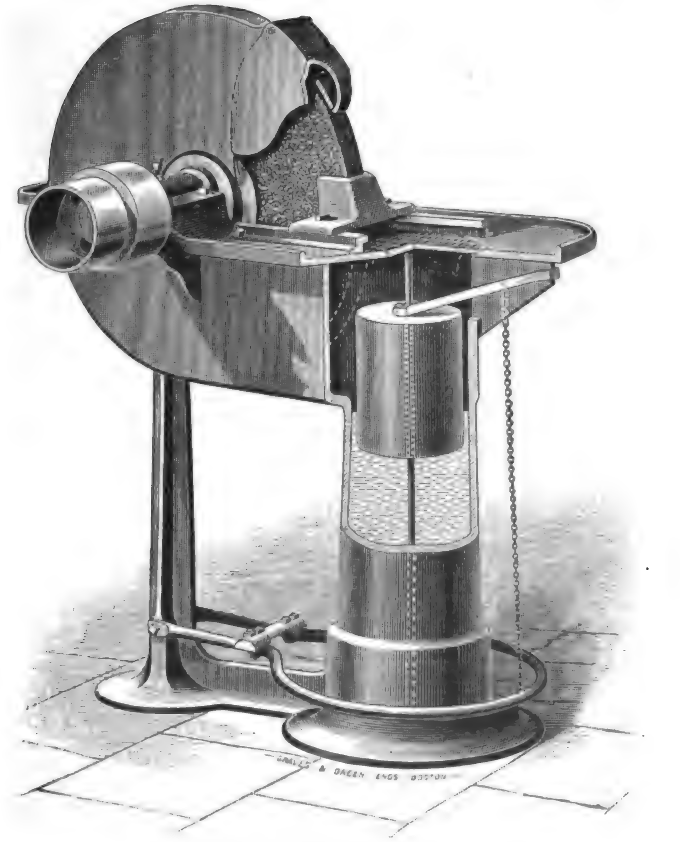
AND MECHANICAL DEPARTMENT.

THE BARNES WATER EMERY GRINDER.

The accompanying engraving represents an improved method of mounting an emery wheel, which possesses advantages which are apparent at a glance. To the front of the treadle, which is pivoted to the rear standard and bent to encircle the water column, is attached a lever, whose free end carries a float. By pressing with the foot upon the treadle, the float may be made to enter the water chamber, thereby displacing the water and forcing it to rise and supply the wheel. When the machine is not in use the float rises and the water settles back out of the way of the wheel. This arrangement does away with all pumps and valves, which are liable to get out of order, simplifies the machine, and makes it more practical under all conditions.

The chamber in which the float is suspended—resting upon the water—is divided from the chamber in which the wheel revolves by a partition, in the lower part of which is a small hole through which the water slowly enters the wheel chamber. The action of the wheel carries the water to the front upper quarter of the wheel, where it is arrested and thrown into a pocket, from whence it falls to the wheel and tool. The pocket is shown in the engraving by the outer shell broken away. Without the partition referred to, the water would be flooded into the wheel in a body or rush, which would not be desirable. The small hole being in the bottom edge of the partition, allows all the water to flow back into the reservoir when the float rises. The curved treadle can be conveniently reached, no matter what position the operator may assume when grinding.

This construction not only greatly simplifies the machine and renders it far more efficient, but it also allows it to be used in



THE BARNES WATER EMERY GRINDER.

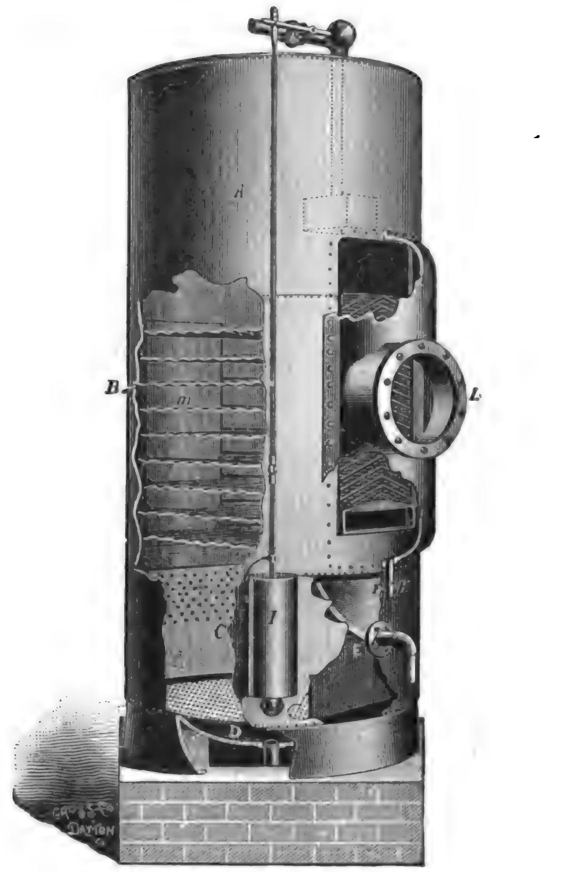
shops where there is no piping. The grinder, which is most substantially made, is built by the W. F. & John Barnes Co., of Rockford, Ill.

SCHIEREN BELTS.

Chas. A. Schieren & Co. have just furnished the Louisville Cotton Mills with 89 feet of 32-inch three-ply patent perforated belt. This is a heavy belt for one of the perforated type. The company report a growing demand for the "perforated," and have still to hear any adverse criticism from users. All who have used it speak in the highest terms of it.

STILWELL'S IMPROVED HEATER AND FILTER COMBINED.

In these days of sharp competition no steampower plant using high pressure engines can be regarded as complete from an economical point of view, unless it is provided with an efficient heater utilizing the exhaust steam for heating the feed water for



STILWELL COMBINED HEATER AND FILTER.

the boilers; and, if at the same time, the heater can be made to thoroughly purify the water so as to prevent the formation of scale in the boilers, its economical value is thereby greatly augmented.

In the Stilwell Patent Improved Heater illustrated in the accompanying engraving its manufacturers claim to offer just such a device, and they further claim to have successfully met all the objections hitherto urged against open heaters.

The characteristic features of the new heater are its very large heating and filtering capacity and also depositing surfaces for receiving the deposits of lime and other impurities. Increased facilities are also provided for quickly and thoroughly cleaning the heater and effectual devices for separating and catching the cylinder oil contained in the exhaust steam. The inflow of cold water is automatically regulated, thus insuring an even and steady feed.

A finely illustrated descriptive catalogue has been issued by the manufacturers, the Stilwell & Bierce Mfg. Co., of Dayton, O., who for more than a quarter of a century have made a specialty of machinery for heating and purifying feed water for steam boilers, a fact which entitles their claims to careful consideration.

IDE AND IDEAL ENGINES.

W. R. Fleming & Co., 174 Fulton street, New York City, agents for "Ide" and "Ideal" engines built at Harrisburg, Pa., have just closed contract for a complete steam plant for the Augusta Mining Co., of New York. The plant will consist of two "Ide" engines, boilers, etc., aggregating 100 h. p. This company are familiar with the "Ide" and "Ideal" engines, and awarded the contract without hesitation.

Other sales this week are reported as follows: One "Ideal" engine, 50 h. p., Vesuvius, Md.; one 70 h. p. steel boiler, and one 20 h. p. "Ide" engine for Chas. Avery, New York; one 20 h. p. "Ideal" for Edison Machine Works; one 30 h. p. engine for Staten Island.

A number of orders are also taken for shafting of William Sellers & Co., and belting of the Jewell Belting Co., for both of whom Fleming & Co. are selling agents.

THE GOULDS TRIPLEX ELECTRIC PUMP.

An interesting circular has just been issued on their triplex electric pumps by the Goulds M'f'g Co., of Seneca Falls, N. Y., and 60 Barclay street, this city. The pump has an extension bedplate to receive motor, and rawhide gears for the motor armature shaft and the pump countershaft. The circular says:—"In a few words the advantages and adaptability of the triplex or three cylinder pump for electric pumping (and these advantages are peculiar to our pump alone) might be best described in that *the pump offers absolutely even and unvarying resistance to motor under all conditions and consumes but minimum power in friction of parts, etc. Its efficiency challenges comparison.*

"The first effect is contributed by action of three-throw crank shaft, in whose stroke there is positively no dead centre or point of varying load productive of jerky motion and attending vibration, water hammer, etc., etc.; while the second effect is the happy result of combined ingenuity and skill in production.

"Our pump can be adapted for any make of motor, though we should be advised general dimensions of same, diameter and speed of armature shaft, and height above base."

Dia. Cyl.	Stroke.	Suction.	Discharge.	Gears.	*H. P.	Rev. per minute.	Gals. per Rev.
1¼ in.	2 in.	¾ in.	¾ in.	5 to 1	1-8	50 to 60	1-35
1¾ "	2½ "	1¼ "	1¼ "	5 to 1	1-2	50 to 60	1-14
2 "	3 "	1¼ "	1¼ "	5 to 1	3-4	40 to 50	1·8
2½ "	4 "	1½ "	1½ "	5 to 1	1	40 to 50	1-4
3 "	4 "	1½ "	1½ "	5 to 1	1	35 to 45	1-3
4 "	4 "	2 "	2 "	5 to 1	3	35 to 45	5-8
4 "	6 "	2 "	2 "	5 to 1	3	30 to 40	4-5
5 "	6 "	3 "	3 "	5 to 1	5	30 to 40	1 1·2
5 "	8 "	3 "	3 "	5 to 1	5	30 to 40	2
6½ "	8 "	4 "	4 "	5 to 1	7½	30 to 40	3¼
8 "	8 "	5 "	4 "	5 to 1	10	30 to 40	5

*The horse-power is but an approximate estimate of mechanical horse-power necessary to elevate water 50 to 100 feet, running pump at 35 to 50 revolutions per minute.

THE ROCKFORD ELECTRIC MFG. CO'S. NEW FACTORY.

The Rockford Electric Manufacturing Co., of Rockford, Ill., have just got settled in their handsome large new factory on the north end corner of Fulton street and Grant avenue. The building is a commodious and handsome one, with a frontage of 50 feet and is 250 feet in depth and also has two large wings. In the front of the building are located handsomely appointed offices, fitted up with all conveniences. The factory comprises a large machine shop fitted up with all the latest and most approved machinery and labor-saving tools and devices for electrical manufacturing, and this portion is almost entirely constructed of glass, thereby ensuring the best of light. This is somewhat of a novel departure, but gives most excellent results. The testing room occupies one of the wings and is furnished with a Willans engine of 100 h. p. and a most complete outfit of testing apparatus, and so arranged that the largest and smallest machines can be tested with equal accuracy. The other wing is occupied as a wood-working and pattern shop and is equipped with all the necessary machinery for this work. A well lighted drawing office nicely fitted up is also a prominent feature. Everything in the arrangement of the whole factory has been carried out with a view to saving of labor and with signal success. The company are doing a large and rapidly increasing business and are just now placing on the market a new street railway system possessed of marked merits and worthy of careful inspection by those in need of equipments of this character.

DIRECT UNITED STATES CABLE COMPANY.

We are indebted to Mr. J. Brown, manager for this country of the Direct United States Cable Co., 40 Broadway, for a very handsome picture beautifully mounted, which can now be seen gracing our office walls. It is 24x18 in., executed in the best style of chromo lithography. In the centre is a huge terrestrial globe, across which, between the New World and the Old, Mercury and Neptune are holding a cable, their hands resting respectively on New York and London. Above this is the name of the company. The cable coils away to each side, first supporting the emblazoned arms of the United States and of England, and then forming a frame to two large sketches showing cable operators at work. Below all this, comes a list of the various offices and branches, and at the foot is a stretch of blue sea and tropical beach, all framed in the cable.

W. F. & JNO. BARNES.

W. F. and Jno. Barnes, Rockford, Ill., manufacturers of machine tools, and a house whose goods are known for their excellence all over the country, are receiving a number of remarkably strong testimonials, one of which is appended:—

ATHENS, OHIO, Nov. 4th, 1890.

DEPARTMENT OF PHYSICS AND ELECTRICAL ENGINEERING,
Ohio University, Athens, Ohio.

TO W. F. & JOHN BARNES CO.,
Rockford, Ill.

Gentlemen:—

We have at our University a steam and electrical plant and as this is extensive it necessitates many repairs. Our apparatus, too, used in chemical and physical work frequently gets out of order. Besides this we construct yearly many pieces of apparatus.

We have now in our lathe room one No. 4 lathe purchased from you some six years since and have recently added your No. 4½ lathe. I find this outfit entirely sufficient to do all the work outlined above.

Besides general work in turning, etc., I find the No. 4½ lathe about perfection for winding magnets and will use it soon for winding magnets for arc lamps. I have examined many lathes but have found none that were simpler or showed better mechanical work both in design and construction.

We use the No. 4 lathe for drilling and polishing wood and brass work. With its hand feed it is admirably adapted for working brass. Though run hard for six years it is still in excellent condition, running true and by means of the device in the head all wear has been taken up.

I regard the velocipede foot motion as the best designed for foot lathes. One can work for hours at a time without experiencing fatigue and I obtain valuable exercise and relaxation in its use.

For turning and screw cutting, the No. 4½ lathe is all that can be desired. The gears are so accurately cut that they work smoothly and with comparatively little noise. The device for reversing is not only very simple but most effective.

Very truly yours,

W. M. STINE, *Prof. Physics.*

DAVENPORT FOUNDRY & MACHINE CO.

The Davenport, Ia., Foundry & Machine Co. have just finished a 75 h. p. Meyer automatic engine for the Clarinda, Ia., Electric Light & Power Co., together with a boiler, pump and heater. They are also building a 50 h. p. Meyer automatic for the Wilton, Ia., Electric Light & Power Co., and will furnish boiler, pump and heater. They built recently a 100 h. p. Meyer engine for the Bettendorf Metal Wheel Co., of Springfield, O., to drive their machinery and several dynamos; also a 100 h. p. for the Deere & Mansur Co., Moline, Ill. They are also furnishing an electric hoist designed by Mr. H. H. Meyer for a mining company in Colorado, built on order from the Hawkeye Co., who supplied the motor.

THE CROSBY EXHIBIT AT THE INSTITUTE FAIR.

Among the electrical exhibits at the American Institute Fair, that of the Crosby Electric Co., 87 & 89 S. 5th Ave., this city, is one of the most interesting. The special feature of this exhibit is that it brings out in a most conspicuous way the multiplicity of uses to which electricity can be applied and for which this company manufactures batteries. There are the "Duplex," the "Eclipse," the "Hussey," blue stone battery and the "Crosby" dry battery, all of which are applied at this exhibit to the purposes for which they are adapted. One of the varied and many uses which this exhibit shows electricity can be applied to is a a novel cigar lighter. Two bronze figures are mounted on a pedestal. Each figure stands holding a cigarette which serves as electrode—about ⅛ inch intervening between them. A bunch of brass wire is fastened to the end of a handle and when not in use is kept in a small receptacle filled with alcohol. When it is desired to secure "a light" the torch which is saturated with alcohol is placed between the points of the cigarettes, and a current causes a spark, igniting the alcohol. The Crosby dry battery is placed in the pedestal, making it self-contained and a valuable feature not only of novelty but of permanent usefulness in any cigar store, restaurant, &c.

THE SEBASTIAN-MAY CO.

On and after Dec. 1, the well known Sebastian-May Co., of Cincinnati, O., will be installed comfortably at Sidney, O. They have issued the following notice: "It gives us pleasure to state, that owing to the rapid and continued growth of our business, we have been compelled to obtain larger manufacturing facilities (the third time within a period of seven years), and have decided upon Sidney, O., on the lines of the Dayton and Michigan and the Cleveland, Cincinnati, Chicago and St. Louis Railroads, where we have secured a large tract of land, upon which has just been completed the erection of commodious brick and stone structures, especially adapted for our business, and which we have supplied with the best and most modern machines, tools and appliances obtainable, for the rapid and economical production of our specialty lathes. This, together with the excellent shipping facilities at our command, will enable us to promptly supply any demands made upon us for our tools.

"Thanking our many customers for past favors, and trusting for a continuance of the same, we extend a cordial invitation to all to visit our new works or write us when in need of lathes or other tools."

THE WIRT LIGHTNING ARRESTER.

The Electrical Supply Co., of Chicago, have issued a neat little descriptive circular on their Wirt lightning arrester. The essential feature of the arrester is a series of plates quite insulated from each other and having a space of from $\frac{1}{1000}$ to $\frac{1}{1000}$ of an inch. The discharge is made to wear itself out in passing over all the breaks in series. The circular gives practical advice as to the right points of intercalation for the arresters in various circuits. The arresters are made in different sizes and voltages.

WESTINGHOUSE ELECTRIC RAILWAY SNOW PLOW.

A new snow plow, to be utilized upon electric street railways, is now being manufactured by the Westinghouse Electric & Mfg. Company, in connection with the Westinghouse system of electric street railway motors.

The appliance differs in a good many respects from the old-fashioned, cylindrically-shaped broom, revolving beneath the body of a truck and sweeping the snow and dirt in all directions.

The Westinghouse snow plow consists of an ordinary car truck equipped with two motors, one of which performs the propulsion of the car, while the other is used to revolve two sets of shovels. These shovels are encased in a circular box, which is so attached to the front of the truck and so designed that it glides closely over the track and the rails of the railway line. As the snow plow moves along, all the snow on the rails is picked up by the circular box. The revolving of the shovels brings the snow to the top of the case, where it is emitted through a spout. This spout can be adjusted with the opening turned towards either side of the car.

The snow plow can be operated night or day, because it is without the objectionable features of the ordinary snow sweeper, which makes a great deal of noise and interferes with the regular traffic upon the streets, as well as being an annoyance to pedestrians. It is of neat appearance and most solidly built.

ELECTRIC LIGHTING IN THE ASHLAND MINE.

The Westinghouse Electric and Manufacturing Co. has just completed the installation of an electric light plant in one of the iron mines of the Lake Superior district. The mine is called the Ashland, owned by the Ashland Iron Mining Company, of Ironwood, Mich.

There are over two thousand people occupied in the mine, which is one of the oldest and richest in the Ironwood mining district. Like most of the mines in the Lake Superior iron ore belt, the Ashland is in some portions considerably damp, and the installation of an electric lighting plant presented therefore a great many difficulties owing to the trouble of accomplishing a thorough insulation of the wires.

The Ashland is 720 feet deep and has eight levels. The descent into the mine is made by means of a number of ladders, each of them being 75 feet in length. The dampness in some parts of the mine was extraordinary, and to succeed in making the insulation perfect, the wiring had to be drawn through Simplex insulating paint, and only the best Okonite was used in the entire plant. The work could only proceed very slowly owing to these obstacles, and it took four months to finish the construction of the wiring.

The generating station of the plant is situated in the pump-house. The plant has a capacity of two 300 light Westinghouse machines. The switch-board is very artistically arranged and is made of a beaten board of white and brown birch wood.

THE MASON BATTERIES.

On Tuesday, Nov. 18, at Old Christ Church, Fifth avenue, and 35th street, N. Y., a private view of a new painting, "The New Ideal of the Christ," was afforded representatives of the press and friends of the artist. The picture was 9¼ x 12½ feet, and was lighted by a 32 c. p. incandescent light which had been chosen for its steadiness. This light was run by the well-known Mason battery, 16 of the No. 11 cells being required. These cells were placed in position on Friday, Nov. 14, and ran, without recharge, until Friday, Nov. 21, the service each day being from 10 A. M. to 10 P. M. There was also a 25 c. p. lamp placed in the dome of the church which was connected to these same batteries. It is estimated that there were about 1,000 feet of wiring in the whole.

WESTON ELECTRICAL INSTRUMENT CO.

A visit to the works of the Weston Electrical Instrument Company, Newark, N. J., found this enterprising concern full of business, and about settled in their new and handsome quarters, 114-116 William street.

The company have every facility in the way of expert help and machinery of the most improved patterns, as well as many ingenious special tools of their own design, for the perfected manufacture of their standard voltmeters and ammeters. They are at present busy perfecting some new instruments in their present line of manufacture, which are expected will shortly be put before the public.

THE EDDY MOTORS IN THE GLOBE TOBACCO FACTORY.

We give below the full text of the letter referred to last week in THE ELECTRICAL ENGINEER in the article on "Electricity in Mill Work":

DETROIT, MICH., Nov. 8, 1890.

THE EDDY ELECTRIC M'F'G. CO.,
Windsor, Conn.

Gentlemen:—We have eight of your motors now in constant use in our factory; seven of them were put in a year ago last May, when we moved into our new building, and a new one has been added to our plant recently. These motors vary from 1 to 15 h. p., and are all giving us excellent satisfaction. They are doing their work faithfully and well, and with very little expense for attention or repairs. The transmission of power by electricity has saved us about 20 h. p. over the old style of transmission by shafting and belts. In addition, we light our factory at no perceptible additional expense. We heartily commend your motors to any who are in need of a good, reliable article.

Very respectfully,
(Signed) GLOBE TOBACCO CO.

MAGNOLIA ANTI-FRICTION METAL.

Evidence showing the great merit of the Magnolia anti-friction metal, accumulates daily. Mr. C. C. Martin, chief engineer and superintendent of the Brooklyn Bridge plant, says regarding his experience with it: "We have used the Magnolia metal for about six months on the crank pin of a 450 h. p. Wright engine, and also as packing rings on the piston rod of one of our locomotives. In both cases it has given entire satisfaction, not causing us the least trouble." The Magnolia Anti-Friction Metal Co., of No. 74 Cortlandt street, N. Y., are naturally pleased at receiving this high tribute to the value of their metal.

THE EDCO STORAGE CAR IN CHICAGO.

On Saturday afternoon, November 22nd, at 2 o'clock, at the invitation of Mr. William Hood, Western manager of the Accumulator Company, of New York, a trip was taken on the Edco storage car over the North Chicago Street Railway Company's line on N. Clark street, from the car barns to Lawrence avenue, by a large party of gentlemen. The car, under the skillful manipulation of Mr. Pfatischer, operated to perfection and accomplished on the return trip the distance of 3¼ miles in 13 minutes. It is run by 88 cells of storage battery manufactured by The Accumulator Company, and two 15 h. p. motors built by the Electro Dynamic Company, of Philadelphia, who also equipped the car with its switches and other details throughout. The car is at all times under perfect control and can be run fast or slow and stopped in a remarkably short space. All expressed themselves as delighted with the operation of the car, and a very pleasant afternoon was spent.

WESTINGHOUSE LIGHTING WORK.

The Westinghouse Electric & Manufacturing Co. received during a recent week, contracts for the installation of alternating current incandescent light plants at the following places: Manchester, N. H., 1500 lights; Cohoes, N. Y., 750 lights; Amesbury, Mass., 500 lights; Aransas Pass, Tex., 750 lights; New Cumberland, W. Va., 750 lights; Rich Hill, Mo., 750 lights.

In addition to this, the alternating current central station plant at Havana, Cuba, is again compelled to increase its capacity. The Havanese intend to furnish all the suburbs of the city with electrical illumination. They purpose to extend the plant for eight miles around the city, and, to this effect, the Westinghouse Electric & Manufacturing Co. has been contracted with to furnish a 2000 volt 750 light plant.

The Westinghouse alternating current arc light system is now being introduced in Norwich, N. Y.

ELECTRIC MINING IN PENNSYLVANIA.

The Mill and Mine Electric Equipment Co., of Pittsburg, Pa., have just completed the entire equipment of another mine with electrical mining machinery, the machinery and appliances being practically the same as those put in the Monongahela Gas Co's. mines at Willock Station, Pa., and fully described and illustrated in THE ELECTRICAL ENGINEER of Sept. 17th. The mine, the equipment of which has just been completed, is the Summerhill, of Mr. Frank Armstrong, at Woodville, Pa., and the machinery is fully meeting the expectations of both the contractors and the mine owners.

A change was made in fitting up this mine in the power

plant by substituting a 9 x 10 Junior Westinghouse engine for the two 12 x 20 Carter engines the results being fully as satisfactory; the ventilating fan is run by steam instead of by electricity, as was the case in the first mine. Though the plant has been in operation but a short time the records so far show that even better results are being attained than in the first mine.

EXTENT OF THE WESTINGHOUSE INDUSTRIES.

The extent of the operations of many of our large concerns, says the Pittsburgh *Chronicle Telegraph*, is not even approximately understood. Of all of the industries in the city, none are more important than those commonly called "Westinghouse enterprises." The frequent reference to the stocks of these concerns, and the fact that they are traded in largely, have prompted an inquiry as to the extent of the present output of the different companies. It must be borne in mind that these concerns have brought new business to this community, and have added to the prosperity of all other interests.

The Westinghouse concerns, and their gross sales for the month just passed, are as follows:

	Gross sales.
Westinghouse Air Brake Co.	$ 687,000
Westinghouse Electric and Manufacturing Co	500,000
Philadelphia Company	250,000
Union Switch and Signal Co.	70,000
Westinghouse Machine Co.	50,000
Fuel Gas and Manufacturing Co.	53,000
Allegheny County Light Co.	28,000
Standard Underground Cable Co.	80,000
Total sales	$1,718,000

These figures may be studied by every Pittsburgher. They are the result of the energy and push of one man, and represent largely, if not altogether, a line of development, outside of those for which our city and section are known. Mr. Westinghouse deserves the recognition which is so seldom accorded originators and creators of industries. Commencing with his air brakes which has brought millions into this city, and his conspicuous labors in the newest fields of electricity, Mr. Westinghouse has always stood in the fore front of industrial life, and acquired a substantial and enduring fame in the annals of progress second to that of no other man. All these business interests, reaching over twenty millions of dollars per annum, have been built up without resort to sensationalism, claptrap or misdirection of any kind.

NEW ENGLAND TRADE NOTES.

THE STANDARD ELECTRIC TIME Co., of New Haven, are installing quite a number of their electric time plants (Warner system) in factories at present, which are giving eminently good service. Amongst their more recent orders is one from the Green and Daniels Manufacturing Company, of Pawtucket, R. I., to equip their factory with one regulator and 23 dial clocks.

THE CROSBY STEAM GAUGE AND VALVE Co., of Boston, have just issued a very handsome catalogue of 135 pages of their numerous specialties in gauges, etc. The book is profusely illustrated with cuts of their well known pressure gauges, safety valves, indicators, lubricators, chime whistles, revolution counters, marine clocks, test pumps, pyrometers, salinometers, thermometers, etc., and all kinds of instruments incidental to the use of steam engines and boilers. Many of the instruments are specialties, and every engineer of an electric light station ought to have one for reference.

WESTERN TRADE NOTES.

MR. G. T. HEWES, the widely known traveling representative of The Great Western Electric Supply Company, has resigned his position and will take charge of the electrical interests of the Ironwood Mining Company, at Ironwood, Mich., and Bessemer. We congratulate the company on their selection, as Mr. Hewes' ability and large knowledge of electrical matters will be of enormous benefit to them.

THE ELECTRIC MERCHANDISE Co., of 11 Adams street, have issued a very tastefully gotten up little circular calling attention to their steel wire track brooms for electric street railways, and they are receiving large orders for these brooms every day. They are made with converging holes or perforations which bring the wires in direct contact with each other, making a solid bunch or mass of wire at the point which comes in contact with the surface of the rail. Boring the holes so that every one converges to a centre makes a scraper as well as a brush.

THE EXCELSIOR ELECTRIC Co., The Rookery, Chicago, through their agent, Mr. L. W. Moyer, have recently closed the following contracts: Geo. Benedict, Munro and Clark Sts., a 7 arc-light plant; the Brevoort House, Madison St., a 7 arc-light plant; Geo. M. Clarke & Co., a 20 arc-light plant and 100 incandescents.

A NEW DEVELOPMENT in the street railway journalistic field is the *Street Railway Review*, which will be published monthly commencing January 1st, 1891, at 218 La Salle street, Chicago, and deal with the management and construction of electric, cable and horse roads and the numerous new inventions in these important industries. It will be the effort of the publishers to present a thoroughly practical, reliable and progressive journal, completely covering the field and devoted to street railway interests. Mr. H. H. Winston, Secy. of Chicago City Ry. Co., is president; Mr. T. L. Kenfield, secretary and business manager, and Mr. F. X. Cicott, formerly director U. S. Mint, San Francisco, treasurer and editor. This force will give the new journal a distinguished prestige.

THE MCGUIRE M'F'G. Co., 122–132 N. Sangamon street, Chicago, with their accustomed business enterprise and push, are just instituting a new department in their extensive works for attaching electric motors, and their necessary gears and equipment to the trucks right in their shops, thus obviating the expense and trouble of shipping the trucks first to the electrical manufacturers and then to the purchaser, and are also arranging a testing department in connection fitted up with all the latest improvements and necessary appliances. This is an important step in advance and will certainly meet with approval.

THE ELECTRIC MERCHANDISE Co., 11 E. Adams street, Chicago, the only company in the United States making an exclusive business of manufacturing electric railway supplies for all systems, are issuing a very tastefully gotten up little circular calling attention to their trolley wire insulators, curve brackets, Englund's patent centre curve insulator, overhead switches and gears and pinions, their facilities for the manufacture of which articles are unsurpassed. Their gears and pinions are all carefully tested before leaving the factory and warranted in every respect; and their rawhide pinions are well and favorably known everywhere. They also make brasses and bearings of a special quality of metal and of the best and most durable quality obtainable.

THE CENTRAL ELECTRIC Co. have obtained patents on a new form of glass insulator, especially designed for heavy railroad work. It is estimated that this insulator will increase the insulation resistance of a line at least 100 per cent. Unfortunately, the cuts describing the article could not be obtained from the artist in time for this issue, but we expect to have them in our next.

GEORGE CUTTER, so well and favorably known among the electrical fraternity all over the country, has opened an office at 333 Rookery, where he will handle electrical specialties and all kinds of electric railway, light and power supplies of merit.

COL. C. F. DUNDERDALE, 331 Rookery, so well known among electrical men in Chicago from his late connection with the Chicago office of The Westinghouse Co., is doing a general electrical contracting business, paying attention to electric street railway, electric light and power plants. He has just closed a contract with the Broad Ripple Rapid Transit Co. of Indianapolis, Ind., to build their new street railway under his supervision. The plant will cost about $85,000, and the storage battery system of the U. S. Electric Car Co. will be used. Col. Dunderdale has several other large contracts in hand which comprise electric railway plants and central stations.

THE CENTRAL ELECTRIC Co. report a continually increasing demand for improved Candee wire, and in order to meet the demand, have stocked their warerooms with a larger quantity than ever. As an instance of their unequaled facilities for doing business in a hurry, they received an order last week for 12,000 pounds of this wire to be shipped with a rush, and the wire was at the freight depot in less than one hour after the order passed through the office.

OKONITE.—The handsome little special circulars got up by the Central Electric Company exhibiting a piece of Okonite wire that has been in use for five years, and which was referred to in these columns in a late issue, has attracted much attention, and the company has received numerous applications for specimen circulars to frame and be kept as souvenirs.

FIGURES OF THOMSON-HOUSTON GROWTH.

The *American Wool Reporter* gives facts and figures obtained from General Manager Coffin, of the company, which are well worth reading: "The company is doing a current business of over $1,000,000 per month. Its expenses, including all charges of any kind and every form of outlay, are less than $750,000, which leaves a profit of over $250,000, or $3,000,000 per annum. At the end of the fiscal year, the surplus, after paying dividends, will be over $6,000,000. . . . Reckoning the net earnings of the company at $3,000,000 per annum, there would be left of this amount, after paying the dividends on the common and preferred, $1,830,000, or, in other words, the paying 7 per cent. on the preferred and 16 per cent. on the common, will use up less than half of the company's net earnings. At the beginning of last February, the company had about 100 lines of electric railways under contract, operating over 1,000 cars. It now has 175 lines, operating about 2,000 cars. In February it had 400 incandescent companies operating between 300,000 and 400,000 lights. Now it has 500 incandescent companies, operating between 500,000 and 600,000 lights. At the beginning of the year it had 68,203 arc lamps. Now it has about 85,000."

THE
Electrical Engineer.

VOL. X. DECEMBER 10, 1890. No. 136.

THE NEW ELECTRIC LIGHT STATION AT WORCESTER, MASS.

BY A. C. SHAW.

To the electrical engineer the history of the rapid growth of the electric light industry in this country is at all times interesting. The change, in a very few years, from the practice of putting plants in any cheap and inconvenient cellar, to the present idea of erecting a suitable edifice built on engineering principles for the reception of electric apparatus, is gratifying, and I am glad to present this week, as an example of modern practice, a detailed description of the new station at Worcester, Mass., which has been generally conceded to be as fine a station as there is now in the country. The Worcester Electric Light Co. have passed through all the stages of growth, from the time when they were first located in a basement on Main street, where they remained for three years, at the end of which period they were running some 250 arc lights on the Thomson-Houston system. At that time they built a new station on High street, where in four years more they increased their business to 475 arc lights and 650 incandescent. Finding themselves again cramped for room, they determined to change their location to one in the suburbs, and to build a station which would be second to none in the country, and where they would have room to follow the natural increase of their business. Accordingly they chose a site on an old mill pond, near the present factory of the Washburn & Moen Manufacturing Co., and have erected a station which can be expected to accomodate them for many years, and where they can get an inexhaustible supply of water for their condensing engines. The work on the new station was begun in July, 1889, and the station has now been in active service for about three months. From the first it was the intention to build a station on the most advanced principles, and it was decided that compound condensing engines should be used, with the very highest economy in the consumption of coal, and the station was accordingly laid out for 2,000 h. p. capacity. The general design of the building can be seen by a glance at the sectional elevation, and the plan, Figs. 1 and 2. The main building in the front is three stories high, or rather two stories and basement, and is 200 feet long by 75 feet wide. Immediately behind the main building and in the centre is the engine room, Fig. 3, a one-story building, while behind that again comes the boiler room, so arranged that there is the least possible distance between the boilers and the cylinders of the engines. The boiler house, of which we present a plan, Fig. 2, is 150 feet long by 46 feet wide, by 23 feet high, with a monitor roof 10 feet wide and 7 feet high. In this room are eight 150 h. p. boilers, built by Messrs. William Allen and Sons, of Worcester, divided into two batteries of four each. These boilers are of the horizontal tubular type with flush front with double smoke doors and double firing doors, and are specially built to run at 125 pounds working steam pressure. They are 6 feet diameter by 18 feet 3 inches long, and have each 124 best lap welded tubes, 3 inches diameter and 17 feet long. The boilers have been built of the best homogeneous steel plate, firebox quality, having a tensile strength of 60,000 pounds, with a reduction area of 55 per cent. and an elongation of 30 per cent. All the horizontal seams have butt joints, with welt inside and out, and are triple rivetted on each side of the joint. The internal size of the firebox is 72 inches long by 72 inches wide. Between the two batteries of boilers there is a special 1,200 h. p. Victor feed water heater, also built by Messrs. Allen & Sons, and heated by live steam, there being, of course, no exhaust steam, the engines being condensing. The water comes from the condenser at 100° Fah., and is raised by this heater to 250° Fah., before entering the boilers, this method of heating the feed water being found to save about 5 per cent. on coal. The smoke-stack is 140 feet high with a 72-inch flue.

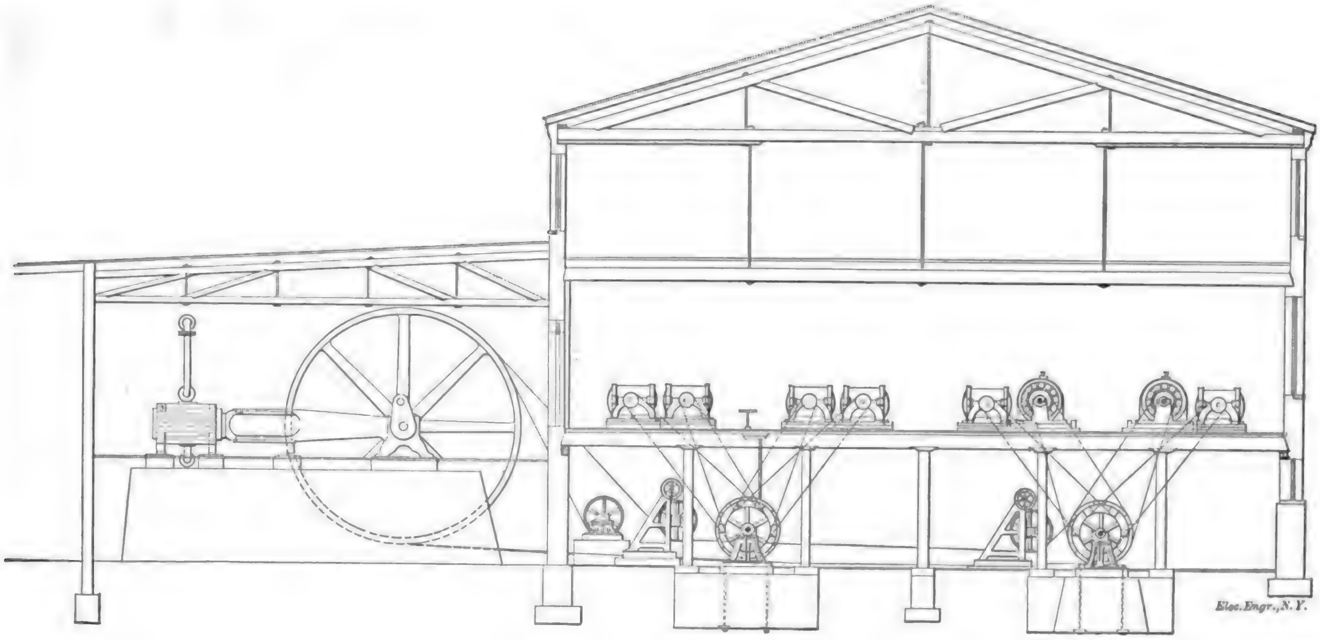


FIG 1.—ENGINE AND DYNAMO ARRANGEMENT, ELEVATION.—WORCESTER, MASS., ELECTRIC LIGHT STATION.

The motive power consists of two pairs of horizontal twin compound condensing engines, of which we present an engraving, Fig. 3, taken from a photograph of the en-

gines in the station. These engines are of the latest improved type, built by the Corliss Steam Engine Co., of Providence, R. I., and embody the latest designs and patented improvements of the late George H. Corliss, the inventor of the Corliss type of engine. The larger engine, the one nearest as shown in the cut, has a high pressure cylinder, 22 inches diameter by 48 inches stroke, and a low pressure cylinder 40 inches diameter by 48 inches stroke, connected with one another by piping and receiver. The pulley fly-wheel is 22 feet in diameter by 52 inch face weighing about 42,000 pounds, and making 70 revolutions per minute, at which speed, with 125 pounds of steam, the engine is rated at 500 h. p. The smaller engine, which is similar in design to the larger, has cylinders 18 inches by 48 inches, and 32 inches by 48 inches, with a pulley fly-wheel 20 feet in diameter by 38 inches face, weighing 35,000 pounds, and making also about 70 revolutions per minute. This engine is rated at 300 h. p. The air pump of the larger engine is 30 inches bore by 12 inches stroke, and of the smaller 26 inches bore by 12 inches stroke, each engine being furnished with a jet condenser and steam trap. These pumps are vertical with levers operated by a connecting rod, as shown in the cut, attached to the extension of the main crank pin. The cylinders are steam jacketed, neatly cased with sheet steel, and are provided with a patent safety relief attachment, for allowing the escape of entrained water. This is an important feature in the successful and safe working of these engines, and the flat spring for operating these relief valves is distinctly seen at the bottom of the nearest cylinder. Another important feature of these engines is the fly-ball governor, with which each engine is fitted, with patented improvements for obtaining more perfect regulation, and for instantly cutting off steam from the engine in case of necessity. Siebert sight feed lubricators are used throughout. The engine room is 94 feet long by 42 feet wide by 26 feet high, there being space for two more engines such as described. The gauges in the engine room were supplied by the Star Manufacturing Co., of Boston.

In the basement of the main building, which is 11 feet high, is situated the line of countershafting, Fig. 4, fitted with "Eclipse" friction clutches, the whole having been supplied by the Holyoke Machine Company, of Worcester, Mass. The foundations for the shafting are somewhat peculiar. A pit 48 inches wide and 5 feet deep, bounded by two twelve-inch brick walls, runs the whole length of the building, and is 8 feet deep under the two main bearings. Under each bearing is a 20-inch pier joining the two walls, and under the main bearings the piers are 36 inches wide. The shafting is made of steel and is 6 inches in diameter. The main pulleys run on a quill with bearings $10\frac{1}{2}$ inches in diameter, so that their weight does not rest upon the shaft, and the engines can be started up without turning the shaft. The shaft is divided into five lengths by means of four "Eclipse" friction clutches, the two for the main pulleys being 52 inches diameter, and the other two being 48 inches diameter. A belt tightener supplied by the Holyoke Machine Company is fitted to

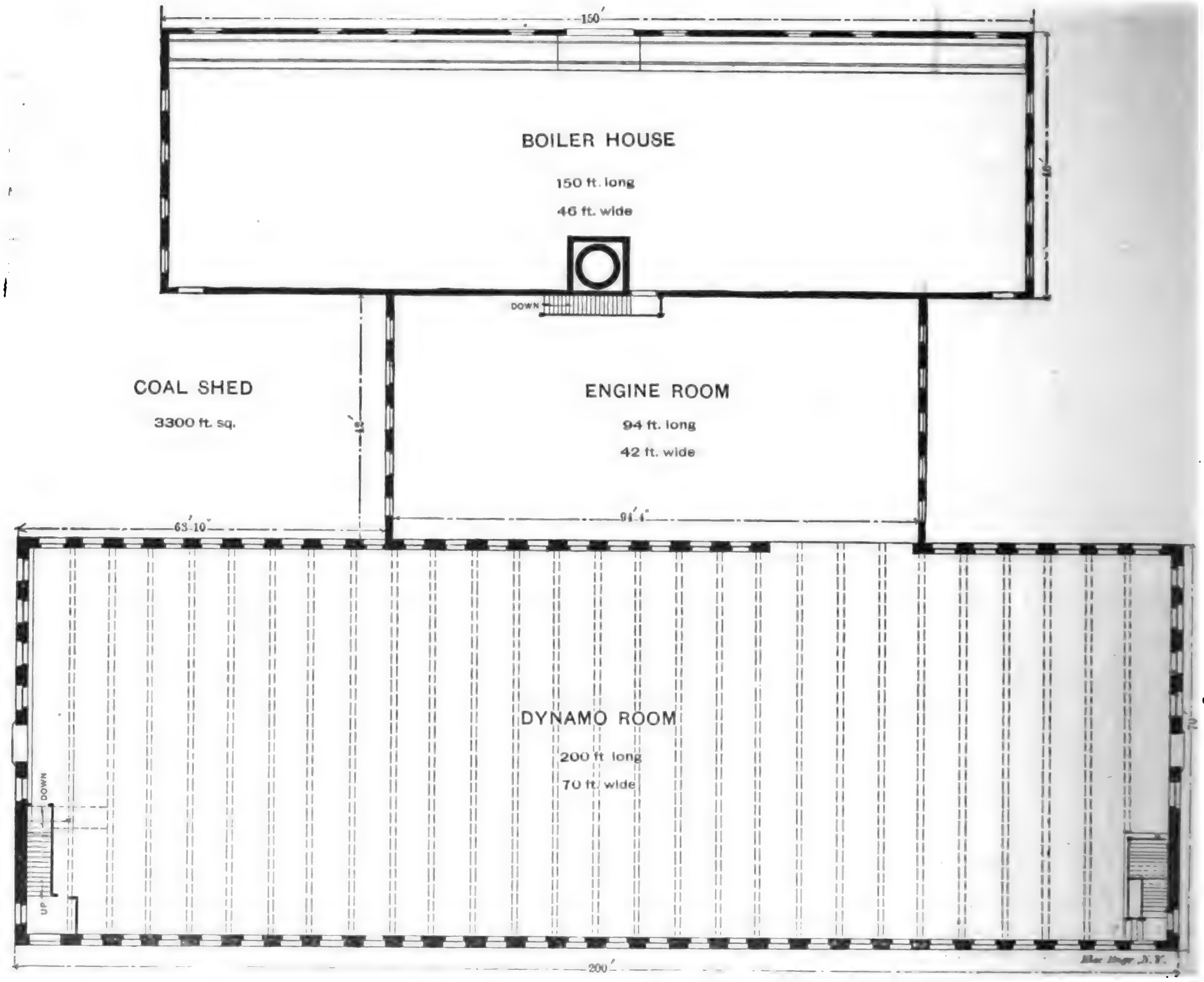


FIG. 2.—STATION OF THE WORCESTER, MASS., ELECTRIC LIGHT CO.—PLAN VIEW.

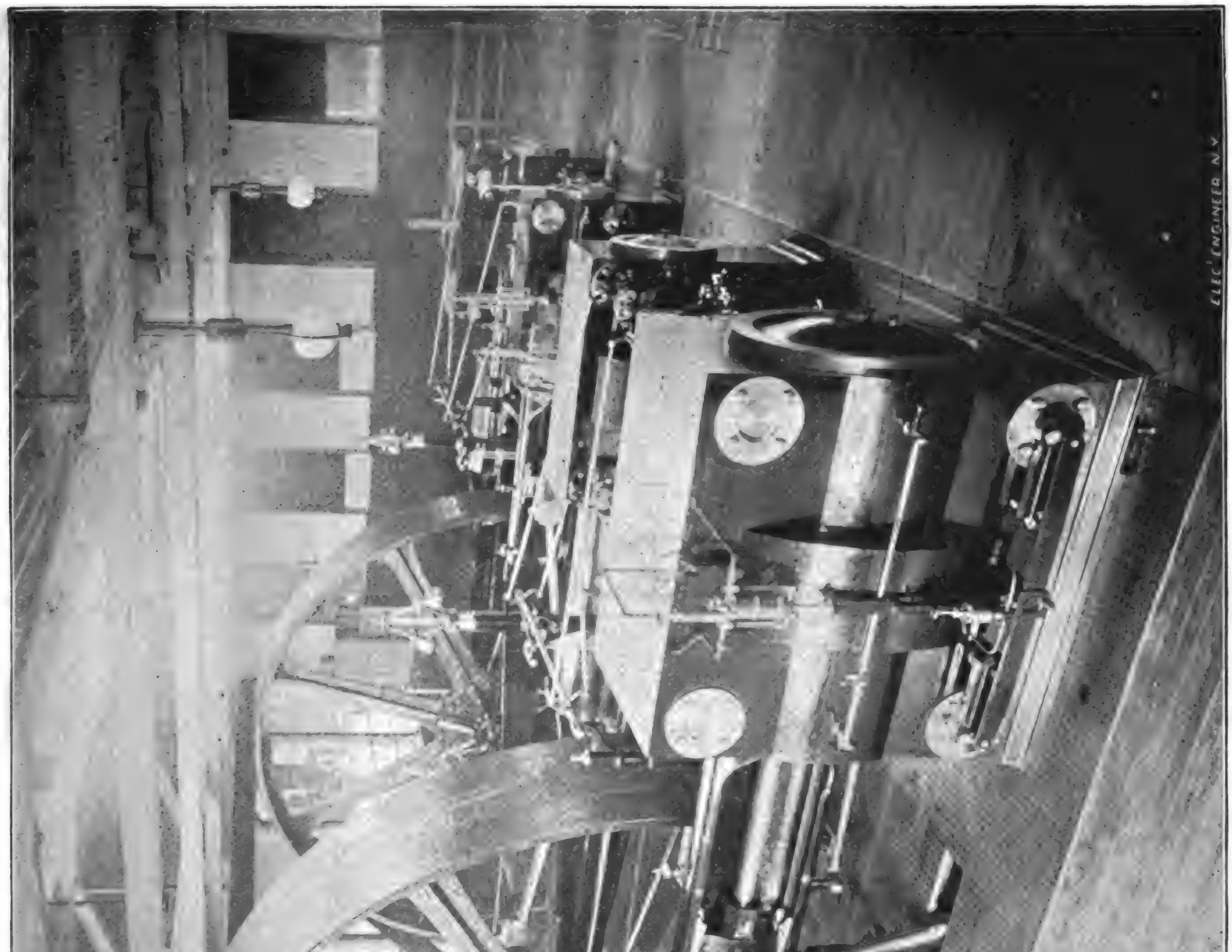


Fig. 8.– Engine Room, and Providence Corliss Engines, Worcester, Mass., Electric Light Station.

each of the two main pulleys. In the basement are 125 brick piers 16 inches square, supporting the floor of the dynamo room above. This floor consists of main timbers 12 inches by 14 inches Southern pine, 2 inch by 4 inch spruce flooring, set up edgewise, and it is finished on top by a $1\frac{1}{2}$ inch maple floor giving it a very handsome appearance. The dynamo room is 200 feet long by 70 feet wide by 14 feet high, giving a floor area of 14,000 square feet, and there is not a single post in it to mar the effect. At present there are 18 arc dynamos and two alternating incandescent dynamos installed in this room, all driven off the one line of shafting, which is capable of accommodating in all 30 dynamos. By installing another line of shafting in the basement, 30 more dynamos can be accommodated in the dynamo room, the whole capacity being for 60 machines. The switchboard is situated in the centre of the dynamo room, and embraces a 24 circuit slate switchboard of the latest type, and a skeleton switchboard for the alternating circuits. It is fitted up with all the usual instruments, voltmeter, ammeter, rheostats, ground detector, etc. The switchboard is situated directly under worthy of note that the station was started without a hitch, the engines and shafting getting down to good work at once, and the boilers being started without having a rivet sweat. My thanks are due to Messrs. Fairbanks and Coughlin for their courtesy in furnishing the above details of their work. They certainly have succeeded in providing themselves with a station which is second to none in the country, and are to be felicitated on the results.

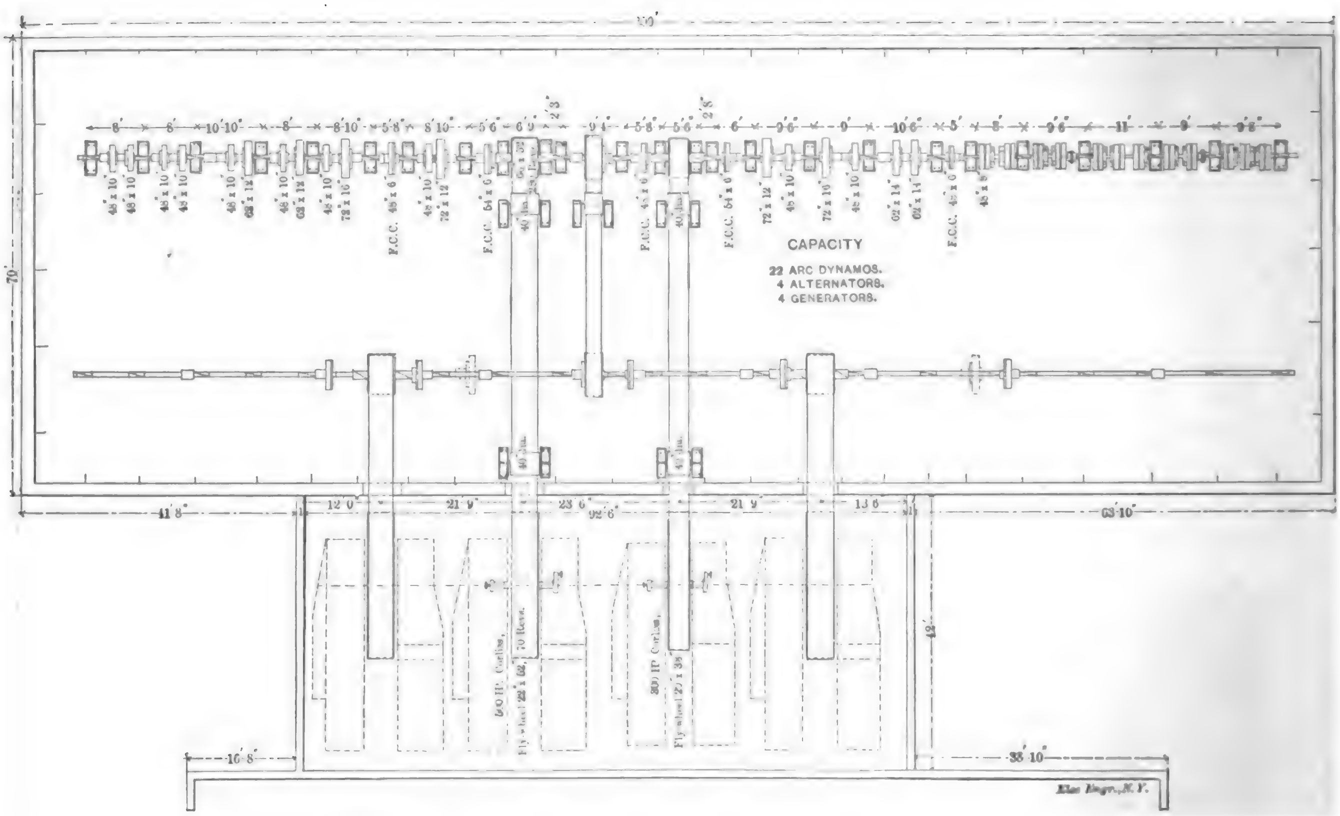


Fig. 4.—Plan of Shafting Arrangement, Worcester Electric Light Station.

the wire tower, which is 48 feet long by 14 feet wide, and which contains the lightning arresters, so that the wires run directly up and out on to the pole line, without touching the building at all.

The upper floor of the building is devoted to the offices and store rooms, of which there are ten, giving ample accommodation for all kinds of stores, which can easily be handled by means of a hydraulic elevator. A locker is also provided here for every employee.

The offices are particularly handsome, and are provided with oak furniture, and polished birch floor. The whole building is of brick, with mill finish, is well lighted throughout and presents a very attractive appearance. The general arrangement has been well designed, attention being wisely given to room for increase. At present the station is supplying current for 550 arc lights of 2,000 candle-power, and about 1,100 incandescent lamps. The whole engineering of the station has been carefully carried out, and it is worthy of note that the station was started without a hitch, the engines and shafting getting down to good work at once, and the boilers being started without having a rivet sweat.

COMPENSATING INSTRUMENTS FOR ALTERNATING CURRENTS.

Until recently there has been considerable difficulty in making alternating instruments, such as voltmeters, at moderate prices. Cheap and accurate direct-current voltmeters have been in the market for some time, but when these were tried on alternating circuits there was found an error of variable magnitude, due to the self-induction of the coils. Messrs. Goolden & Evershed have eliminated this source of inaccuracy by putting non-inductive resistance in series with the active coil, and a coil with a large time constant in shunt to it. This arrangement, which is very simply made, allows the cheap forms of electro-magnetic voltmeters to be used for alternating currents. The chief difficulty that had originally to be got over in making such instruments for direct currents was that due to hysteresis, which gives rise to errors under a decreasing pressure. This error does not come in in alternating work, so that we shall now have a still more accurate cheap alternating current voltmeter.

A CHAIR OF INDUSTRIAL ELECTRICITY.

The Minister of Commerce has just created at the Conservatoire of Arts and Sciences, a chair of industrial electricity, and the Académie des Sciences was invited to present a list of candidates for the new chair. There were three candidates for the post, MM. Marcel Deprez, Hospitalier, and Mercadier, and the President of the Republic, upon the recommendation of the Académie des Sciences, nominated M. Marcel Deprez.

A PRACTICAL GUIDE TO THE TESTING OF INSULATED WIRES AND CABLES.—IV.

BY HERBERT LAWS WEBB.

KEYS.

THE keys in general use for cable testing are three in number; first, the *battery* key; second, the *discharge* key; and third, the *short circuit* key.

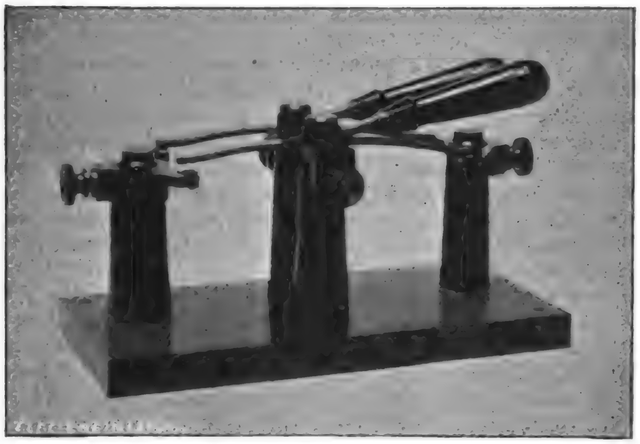


FIG. 14.—RYMER-JONES REVERSING KEY.

The form of battery key illustrated in Fig. 14 is far superior to that usually employed and shown in Fig. 15. The ordinary reversing key is both clumsy and inconvenient. If the instruments are at all crowded, the cams are difficult to get at without touching the terminals of the key, and if a powerful battery is in use this may result in the reception of a smart shock. Other objections are, that unless the workmanship is of the very best, the cams are apt to bind and work stiffly, and that the construction of the key greatly favors the accumulation of dust. As the contacts depend only upon pressure, the efficiency of the key is soon impaired by the contact points becoming dusty and dirty, while their position renders cleaning

FIG. 15.—BATTERY REVERSING KEY—OLD FORM.

a matter of considerable difficulty unless the key is taken apart.

The battery key illustrated in Fig. 14, known as the Rymer-Jones key, consists of two brass levers pivoted on hard rubber pillars and provided with hard rubber handles, by which they can be moved in one direction or the other. These levers make contact at either end with little platinum springs fixed to the ends of crescent-shaped brass plates also mounted on hard rubber pillars. To the under surface of both ends of the levers are fixed platinum contact plates. The hard rubber handle of the left hand lever is provided with a projecting lug of the same material, so that one movement suffices to throw over both the levers. The two poles of the battery are connected to the terminal screws of the crescent-shaped plates, and to the terminal screws on the pivots of the levers are connected line and earth. A simple movement of the hard rubber handles puts either pole of the battery to line, and if the handles are separated, so that the levers are free of the front plate and both in contact with the back plate, the battery is insulated and the line is put to earth through part of each lever and the rear plate.

The advantages of this key are its great simplicity—as even with the roughest treatment it would be difficult to get it out of order—and its good insulation and freedom from accumulation of dust. The contacts being made by two rubbing surfaces they are kept clean automatically by the friction from constant use. The handles are well above the terminals and contact plates, so that there is no risk of touching any of the metal parts when manipulating the key.

The *discharge key* is used, as its name implies, for discharging a condenser or cable. It has three connections,

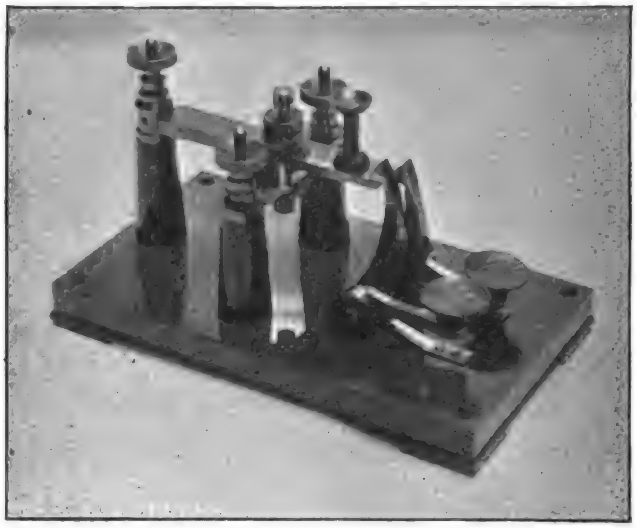


FIG. 16.—THE KEMPE DISCHARGE KEY.

one for the condenser or cable, one for the battery, and one for the galvanometer through which the discharge current is allowed to flow in order to obtain a deflection. The necessary parts of the key, therefore, are a hinged lever to which the cable or condenser is connected, a lower contact connected to the battery upon which the lever is pressed to charge, and an upper contact connected to the galvanometer, against which the lever flies when released. A trigger to engage with the end of the lever and hold it down against the lower contact for charging, or midway between the two contacts when it is desirable to insulate the charged cable or condenser, completes the key.

These necessary parts have been made up in various different patterns, among which the best and most useful are the Kempe discharge key, Fig. 16, and the Webb key, Fig. 17. In the former, a stout lever of brass, hinged at one end, plays between an upper and a lower contact; the free end of the lever, when pressed on the lower contact, is held by two triggers pivoted in front of the lever and actuated by ebonite knobs. One of these knobs is marked "Discharge" and the other "Insulate." If the knob marked "Insulate" is depressed, the lever is released from the lower contact, but is caught by one of the triggers before it reaches the upper contact; the knob marked "Discharge," when pressed, allows the lever to fly all the way up, whether it is in the insulated position or pressed

down against the lower contact. This arrangement is effected by means of an engagement between the two triggers which causes both to be withdrawn when the "Discharge" knob is pressed, while only one is withdrawn when that marked "Insulate" is pressed. The pivot of the lever and the two contact plates are mounted on hard rubber pillars.

The Webb key is of simpler construction but not quite so automatic in its movements, although the insulation is better and there is no risk of confusion, there being only one trigger. It consists of a long brass lever pivoted at one end and pressed upward against a contact by a stiff spring. Immediately in front of the free end of the lever is a hard rubber trigger, pivoted to the base of the key, carrying a projecting strip of brass, which holds the lever down when it is pressed against the lower contact. The end of the lever has a step cut in it, so that if the trigger is pulled outward slightly, the lever is released from the lower contact, but is held before reaching the upper contact by the projecting brass strip catching the step; the lever is then insulated. On pulling the trigger out a little further the lever is wholly released and brings up against the upper contact, effecting the discharge. Of course, if the trigger is pulled out sharply at first, the lever flies at

FIG. 17.—THE WEBB DISCHARGE KEY.

once from the lower contact to the upper, making the discharge instantaneously.

The reason for these attachments for insulating the lever is to enable a discharge taken after the cable has been charged, and then insulated for a certain time, to be compared with the instantaneous discharge. For instance, if a cable is charged for fifteen seconds and then discharged instantaneously, a certain deflection will be obtained; but if it be charged for fifteen seconds, then insulated for one minute, and then discharged, the deflection will be less than that obtained with the instantaneous discharge, because a slight discharge has been taking place through the dielectric to earth. In the case of a good submarine cable submerged in deep water, this difference will be very slight—about three per cent.—but in a cable having a low insulation there would be a much greater difference.

CHAIN MOTORS FOR MINES.

ONE of the latest motors designed by Mr. Albion T. Snell for coal mines obviates the disadvantages of the excessive weight of the locomotive needed to gain sufficient friction on stiff inclines, by having a continuous chain gear. The chain is fixed at each end of the gallery, and passes around the sprocket wheel of the electric motor on the locomotive, thus hauling the train of trucks along. This arrangement has been found far more practical in special cases than the simple locomotive for hauling.

PLANT EFFICIENCY WITH OPEN AND CLOSED CIRCUIT TRANSFORMERS.

BY WILLIAM STANLEY, JR.

SEVERAL contributions on the relative merits of the closed and opened circuit transformers for the distribution of electrical energy, have lately appeared in THE ELECTRICAL ENGINEER. In various letters, Mr. Swinburne has maintained that the open circuit transformer is more efficient than is its opponent of the closed magnetic circuit type, and that, consequently, American engineers were applying and advocating apparatus lacking maximum efficiency.

When, in 1885, I constructed the first closed circuit transformer, and adapted it for commercial lighting, I had in mind the very differences which are now being discussed, and at that time there seemed to me to exist certain objections to open circuit transformers which still appear to me to be of such magnitude that I believe, in America at least, the open circuit transformer is at a disadvantage. Of these objections I have seen no mention; they are briefly as follows:

In the open circuit transformer of the Ruhmkorff, the Gaulard and Gibbs, or the Hedgehog type, high efficiency is due to the fact that the fluid (or air) portion of the magnetic circuit causes the current phase to lag behind the E. M. F. more than in the closed magnetic type, and in a well constructed transformer of the open circuit type this lag is nearly 90 deg. at no load, that is, when the secondary circuit is open. Now in these transformers the value of the primary current varies comparatively little with the load derived from the secondary circuit, and when such a transformer is gradually loaded, the primary current will remain, roughly speaking, constant, while the lag of the current behind its E. M. F. will diminish; the phases of current and E. M. F. more nearly coinciding as the energy taken from the transformer is increased.

In the closed circuit type of transformer, however, the *value of the primary current in amperes* is very nearly in direct proportion to the load upon the secondary circuit. Thus, while the primary current in the open circuit type remains, roughly speaking, constant, possibly varying 10 to 20 per cent., the primary current in the closed type is proportional to the load.

Let us examine briefly the station requirements for the two contrasted types. With the open circuit type eight-tenths of the station plant, that is, eight-tenths of all the engines and dynamos, must run continually to supply the primary currents, for the ampere value of these currents is about constant; while with the closed circuit type of transformer, the engines and dynamos in service vary in proportion to the number of lamps burning. Thus, in a station having 10 dynamos and engines of equal size, in many places one dynamo and engine will easily supply all the energy necessary during twelve or fourteen hours out of the twenty-four, when the closed circuit or American type of transformer is used; while, with the open circuit type advocated by Mr. Swinburne, at least eight of such engines or dynamos would be required to do the same work. The question arises, therefore, Which system uses the least fuel, and costs the least?

For the sake of simplicity, we will allow Mr. Swinburne's transformer to have 100 per cent. efficiency. We will also allow the closed circuit transformer an efficiency of 95 per cent. which can be proven to be commercial practice in well designed transformers. Placing the engine losses at 10 per cent. and the dynamo losses at 10 per cent. and neglecting the losses in the mains, we find that with the open circuit type the loss is eight times as much as with the closed type, neglecting transformer losses; or 7.6 times, including these losses. In short, it requires about seven to seven-and-a-half times as much coal to maintain current for open circuit as for the closed circuit type, because, during the idle period of the day, approximately seven to

eight times as many dynamos and engines have to be run, and the principal losses occur in these elements instead of in the transformers. During the remainder of the day, about one-half of the time, that is, a quarter of a complete day, the efficiencies of the systems employing these two types would be equal; and during the remaining quarter of the day the efficiency of the open type would be 5 per cent. greater.

I therefore dispute Mr. Swinburne's statement that an open circuit transformer is as efficient an element of a system of distribution as its American brother. With higher frequency the open circuit transformer will make a better showing, and probably will be used, providing we can arrange means to obviate the extra losses.

By the way, why use the words converter or transformer? Would not Cyclotrope or Ergotrope, meaning that which transfers from a circuit, and that which transfers energy, be more appropriate?

AN AMPERE-FOOT TABLE FOR CALCULATING DYNAMO AND MOTOR WINDINGS.

BY LEMUEL WM. SERRELL, M. E.

About a year ago, in conversation with Mr. W. F. D. Crane, an electrical engineer well known to the readers of this journal, I was discussing different ways for quickly calculating the proper size of wire to use on dynamo electric machines. Mr. Crane suggested the use of the absolute ampere-foot, saying that he had found it very useful in his work. Since then I have worked out a complete table based upon this suggestion, and as it has proved valuable I take pleasure in giving it to the public.

The adapting of wire to various machines, to produce the desired magnetic effect, is frequently a timetaking and trying calculation. The work is comparatively small when the frame is of a standard size and the number of turns of wire of different sizes that the bobbin will hold, and the resistance of each, is known. When, however, we know that a dynamo or motor requires a certain number of ampere-feet to produce the required saturation, a table from which the size of wire to be used may be read at a glance will be a benefit to those doing this kind of work.

The accompanying is a table of absolute ampere-feet, for different sizes of wires under different voltages, and has been determined by dividing the E. M. F. by the resistance of one foot of wire, which gives the number of amperes that will flow through one foot of wire under the given pressure; or, conversely, the number of feet of wire whose resistance is such that one ampere will flow through it, under the pressure given. Thus, no matter what length of wire we use, the ampere-feet will be the same under any given pressure, and will be that given in the table. Knowing the number of ampere-feet required to produce the desired degree of saturation, we simply look in the table, in the same line that the E. M. F. to be used is given, until we find the nearest number corresponding to the required ampere-feet, and we have the size wire to be used given at the top of the column.

Let us take an example.

A 10 h. p. 220 volt C. & C. electric motor, requires 17,400 ampere-feet to produce the necessary saturation. What size wire must be used?

As the fields of this machine are in series and each requires 17,400 ampere-feet to produce the necessary saturation, the total ampere-feet on the two fields will be 34,800. We now look in the line opposite 220 volts, where we find that 34,430 ampere-feet is the nearest number to that required. Looking at the top of this column we find No. 18 wire must be used.

Table of Absolute Ampere-Feet. B. & S. Gauge.

Volts.	10,000 = $\frac{10\text{ V.}}{C}$ No. 10 wire.	7,932 = $\frac{10\text{ V.}}{C}$ No. 11 wire.	6,290 = $\frac{10\text{ V.}}{C}$ No. 12 wire.	4,988 = $\frac{10\text{ V.}}{C}$ No. 13 wire.	3,861 = $\frac{10\text{ V.}}{C}$ No. 14 wire.	3,210 = $\frac{10\text{ V.}}{C}$ No. 15 wire.	2,488 = $\frac{10\text{ V.}}{C}$ No. 16 wire.	1,973 = $\frac{10\text{ V.}}{C}$ No. 17 wire.	1,565 = $\frac{10\text{ V.}}{C}$ No. 18 wire.	1,206 = $\frac{10\text{ V.}}{C}$ No. 19 wire.	984 = $\frac{10\text{ V.}}{C}$ No. 20 wire.	780 = $\frac{10\text{ V.}}{C}$ No. 21 wire.	619 = $\frac{10\text{ V.}}{C}$ No. 22 wire.	490 = $\frac{10\text{ V.}}{C}$ No. 23 wire.	389 = $\frac{10\text{ V.}}{C}$ No. 24 wire.	309 = $\frac{10\text{ V.}}{C}$ No. 25 wire.	244 = $\frac{10\text{ V.}}{C}$ No. 26 wire.	194 = $\frac{10\text{ V.}}{C}$ No. 27 wire.
50	50,000	39,660	31,450	24,940	19,305	16,050	12,440	9,865	7,825	6,030	4,920	3,900	3,095	2,450	1,945	1,545	1,220	970
60	60,000	47,592	37,740	29,928	23,166	19,260	14,928	11,838	9,390	7,236	5,904	4,680	3,714	2,940	2,334	1,854	1,465	1,164
70	70,000	55,524	44,030	34,916	27,027	22,470	17,416	13,811	10,955	8,442	6,888	5,460	4,333	3,430	2,723	2,163	1,708	1,358
80	80,000	63,456	50,320	39,904	30,888	25,680	19,904	15,784	12,520	9,648	7,872	6,240	4,952	3,920	3,112	2,472	1,952	1,552
90	90,000	71,388	56,610	44,892	34,749	28,890	22,392	17,757	14,085	10,854	8,856	7,020	5.571	4,410	3,501	2,781	2,196	1,746
100	100,000	79,320	62,900	49,880	38,610	32,100	24,880	19,730	15,650	12,060	9,840	7.800	6,190	4,900	3,890	3,090	2,440	1,940
110	110,000	87,252	69,190	54,868	42,471	35,310	27,368	21,703	17,215	13,266	10,824	8,560	6,809	5,390	4,279	3,399	2,684	2,134
120	120,000	95,184	76,480	59,856	46,332	38,520	29,856	23,676	18,780	14,472	11,808	9.360	7,428	5,880	4,668	3,708	2,928	2,328
130	130,000	103,116	82,770	64,844	50,193	41,730	32,344	25,649	20,345	15,678	12,792	10,140	8,047	6,370	5,057	4,017	3,172	2,522
140	140,000	111,048	89,060	69,832	54,054	44,940	34,832	27,622	21,910	16,884	13,776	10,920	8,666	6,860	5,446	4,326	3,416	2,716
150	150,000	118,980	95,350	74,820	57,915	48,150	37,320	29.595	23,475	18,090	14 760	11,700	9,285	7,350	5,835	4,635	3,660	2,910
160	160,000	126,912	100,640	79,808	61,776	51,360	39,808	31,568	25,040	19,296	15,744	12,480	9,904	7,840	6,224	4,944	3,904	3,104
170	170,000	134,844	106,930	84,796	65,637	54,570	42,296	33,541	26,605	20,502	16,728	13,260	10,523	8,330	6,613	5,253	4,148	3,298
180	180,000	142,776	113,220	89,784	69.498	57,780	44,784	35,514	28,170	21,708	17,712	14,040	11,142	8,820	7,002	5,562	4,392	3,492
190	190,000	150,708	119,510	94,772	73,359	60,990	47,272	37,487	29,735	22,914	18,696	14,820	11,761	9,310	7,391	5,871	4,636	3,686
200	200,000	158,640	125,800	99,760	77,220	64,200	49,760	39,460	31,300	24.120	19,680	15,600	12,380	9,800	7,780	6,180	4,880	3,880
210	210,000	166,572	132,090	104,748	81,081	67,410	52,248	41,433	32,865	25,326	20,664	16,380	12,999	10,290	8,169	6,489	5,124	4,074
220	220,000	174,504	138,380	109,736	84,942	70,620	54,736	43,406	34,430	26,532	21,648	17,160	13,618	10,780	8,558	6,798	5,368	4,268
230	230,000	182,436	144,670	114.724	88,803	73,830	57,224	45.379	35,995	27,738	22,632	17,940	14,237	11,270	8,947	7,107	5,612	4,462
240	240,000	190,368	150,960	119.712	92,664	77,040	59,712	47,352	37,560	28,944	23,616	18,720	14,856	11,760	9,336	7,416	5,856	4,656
250	250,000	198,300	157,250	124,700	96,525	80,250	62,200	49,325	39,125	30,150	24,600	19,500	15,475	12,250	9,725	7,725	6,100	4,850
275	275,000	218,130	172,975	137,170	106,177	88,275	68,420	54,257	43,037	33,165	27,060	21,450	17,022	13,475	10,697	8,497	6,710	5,335
300	300,000	237,960	188,700	149,640	115,830	96,300	74,640	59,189	46,950	36,180	29.520	23,400	18,570	14.700	11,670	9,270	7,320	5,820
315	315,000	249,858	198,135	157,122	121,621	101,115	78,372	62,149	49,297	37,989	30,996	24,570	19,498	15,435	12,253	9,733	7,686	6,111
330	330,000	261,756	207,570	164,604	127,413	105,930	82,104	65,109	51,645	39,798	32,472	25,740	20,427	16,170	12,837	10,197	8,052	6.402
350	350,000	277,620	220,150	174,580	135,135	112,350	87,080	69,055	54.775	42,210	34,440	27,300	21,665	17,150	13,615	10,815	8,540	6,790
400	400,000	317,280	251,600	199,520	154,440	128.400	99,520	78,920	62,600	48,240	39,360	31,200	24,760	19,600	15,560	12,360	9,760	7,760
440	440,000	349,008	276,760	219,472	169,884	141,240	109,472	88,812	68,860	53,064	43,296	34,320	27,236	21,560	17,116	13,596	10,736	8,536
500	500,000	396,600	314,500	249,400	193,050	160,500	124,400	98,650	78,250	60,300	49,200	39,000	30,950	24,500	19,450	15,450	12,200	9,700
600	600,000	475,920	377,400	299,280	231,660	192,600	149,280	118,380	93,900	72,360	59,040	46,800	37,140	29,400	23,340	18,540	14,640	11,640

Each field magnet of this machine, in practice, is wound with 7,000 turns of No. 18 wire, and has 1,250 cir. mils per ampere of current flowing through it, which is sufficient to prevent its heating perceptibly.

Sometimes, for special windings, it is necessary to put a few more turns of wire on the armature than that calculated, in order to accommodate the wire to the size and sections of the armature. In this case, to preserve an uniform speed, it is necessary to change the field winding, and frequently the ampere-feet thus obtained will be about half way between the two nearest values found in the table. This shows that either the fields must be wound with a combination of the two wires, or a supplementary resistance must be used to produce the desired result. This is the case with the 4 h. p. 220 volt motor of the C. & C. type, the total ampere-feet of which are 15,400. By reference to the table we see that the size of

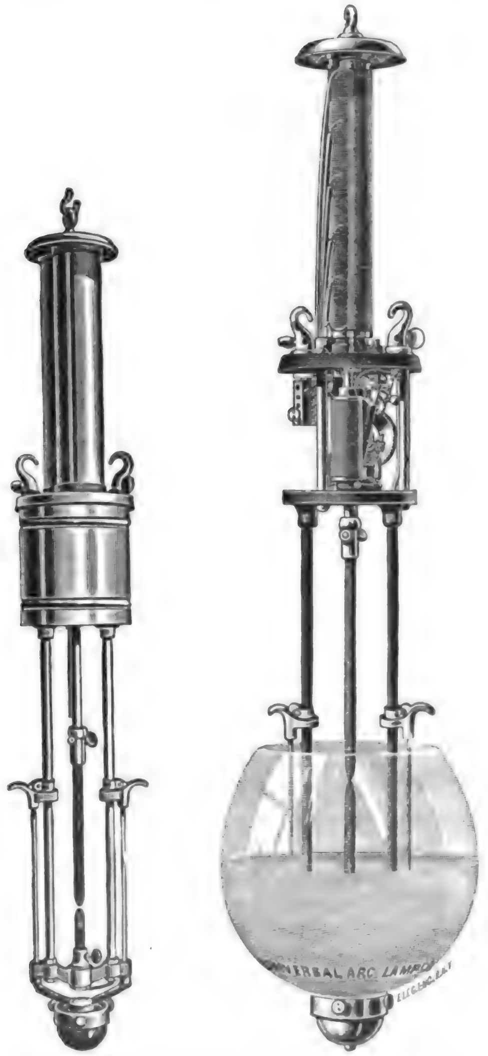
wire to be used is between No. 21 and No. 22. In actual practice the machine is wound with No. 21, and a few turns of German silver wire are wound on the outside of the field to give the required resistance.

Let us take another example. An Edison No. 6 dynamo requires 40,600 ampere-feet of wire on both fields at 125 volts. What size wire shall be used?

By reference to the table we find that a No. 15 B. & S. wire is required. In practice, No. 17 B. W. G. wire is used, the circular mils of which are 3,364 which is the nearest to a No. 15 B. & S. wire having 3,256 circular mils. The numbers given at the top of each column and designated as equal to 10 volts are multipliers by which to determine the ampere-feet for any pressure not given in the table. Thus, if we want to know the ampere-feet in a No. 14 B. & S. wire, at 136 volts pressure, we multiply 3,861 by 13.6 and obtain 52,509 as the required number.

THE "UNIVERSAL" ARC LAMP FOR INCANDESCENT CIRCUITS.

The restrictions which are being placed in some cities upon the running of overhead arc light wires, and, on the other hand, the general distribution of the incandescent current now available in nearly every city, has brought



FIGS. 1 AND 2.—THE UNIVERSAL ARC LAMP.

the arc lamp run on incandescent circuits into considerable prominence.

The nature of the incandescent circuit is such that the lamp mechanism must protect it from a dead short circuit, such as would be the case if the carbons were permitted to touch each other for any length of time. On the other hand, the lamp ought to be so constructed that it can readily be applied to circuits differing in potential within considerable limits. These qualities have been well worked out in the lamp made by the Universal Arc Lamp Co., of this city, as illustrated in the accompanying engravings.

FIG. 3.—MECHANISM OF UNIVERSAL ARC LAMP.

The lamp complete, which is shown in Fig. 1, has its mechanism enclosed within a case, the top and bottom of which are made of slate. The mechanism shown in Fig. 3, consists of a regulating magnet M wound to nearly 500 ohms resistance and allowing but .03 ampere to pass. This magnet acts upon the armature A and its strength is, of course, dependent upon the length, and hence upon the resistance of, the arc to which the magnet M is placed in shunt. As the length of the arc increases with continued burning, the armature A is attracted, until finally it trips a pawl and ratchet motion which allows the carbon to feed until it has again resumed the proper length of the arc.

The construction is such that when the carbon is completely burned the shunt magnets are automatically cut out by being released from the end of the carbon rod. Altogether there are three paths for the current from the terminal to the carbon rod so that under no conditions can sparking occur at the contacts in the mechanism. As will be seen in Figs. 2 and 3, the hood of the lamp carries within it a resistance R which is wound in sections and connected to a block of insulating material B. As before stated, provision ought to be made in lamps of this description which will permit of their being operated on circuits having different potentials. It is with the object of allowing of this that the resistances just referred to are provided. By their use the lamp can be placed on circuits varying from 95 to 125 volts. By inserting the screw S and making contact with the proper resistance terminal, the lamp can be adapted for any circuits within the range just mentioned. Thus, with the highest voltage, all the resistances would be included, while with the lowest they would all be cut out.

Another interesting feature of the lamp is the convenient means by which the globe can be removed for trimming. As will be seen in Fig. 2, the globe is supported on a circular base which is carried by two rods provided with clamps at their upper ends, which firmly grip the side rods of the lamp. By pressing the thumb upon these clamps it releases them and allows the globe to be slid down free of the carbons. Special attention has been paid to the ventilation of the hood and also of the works in the lamp. The lamps are designed to run two in series and thus to avoid the use of dead resistances and their consequent waste where only one lamp alone is used.

THE BURNET DOUBLE POLE SWITCH.

The rules of the boards of fire underwriters now generally require the employment of double-pole quick-acting switches in connection with electric lighting or power distribution within buildings, and in order to meet the re-

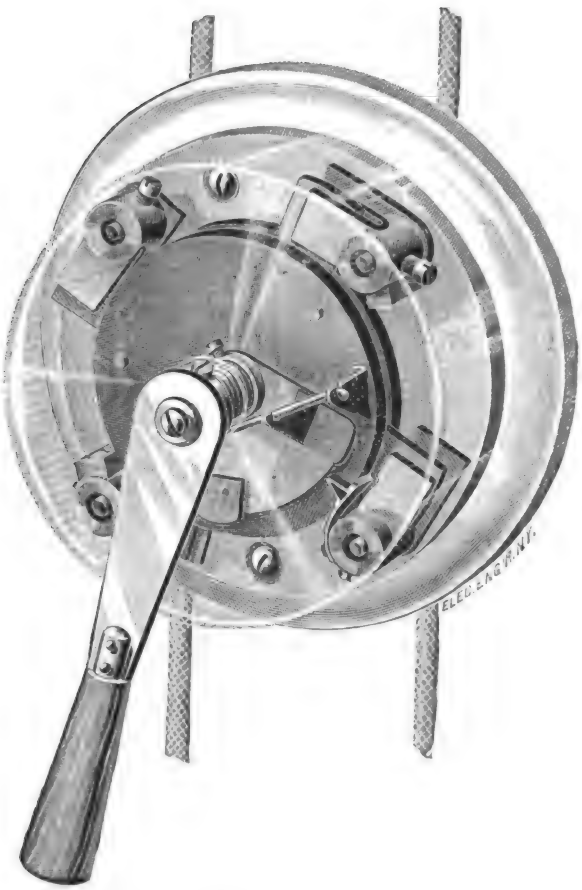


Fig. 1.—The Burnet Double-Pole Switch.

quirements in a simple manner, Mr. W. H. Burnet, of East Orange, N. J., has recently designed the apparatus illustrated in the accompanying engravings.

The switch, which is shown in Figs. 1 and 2, consists of a base upon which are mounted two discs of vulcanized fibre carrying between them the double pole contacts.

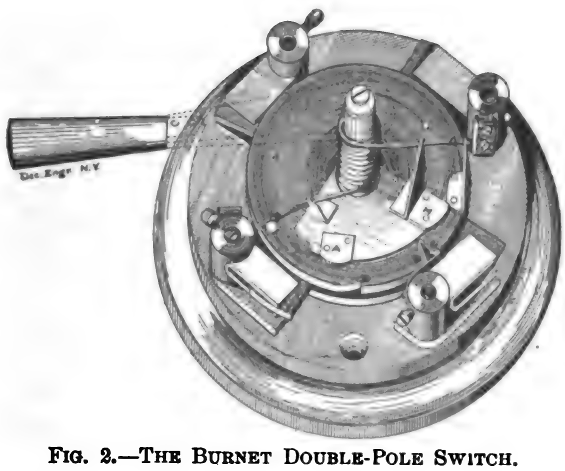


Fig. 2.—The Burnet Double-Pole Switch.

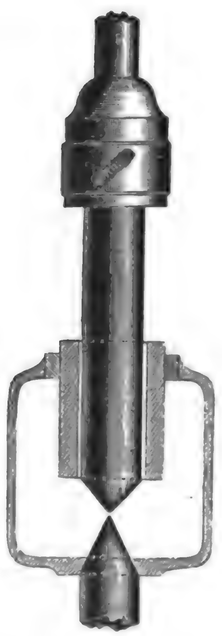
Encircling the spindle is a spiral spring, one end of which presses against the stop G and the other against the stop F. The vulcanized fibre disc is provided with notches B and C into which the latch D engages at either end of the throw of the switch. The spindle also carries a brass sector provided with cams A and E, which are arranged to pres upon the latch D.

The action of the switch will now be readily understood. In the position illustrated, the handle is turned to the left until the cam A strikes the latch D. The turning of the handle puts the spring in tension and the instant the latch is released the action of the spring throws the switch over, breaking contact at four points. When it is desired to close the switch, the handle is turned in the reverse direction until the cam E strikes the latch, when the switch is thrown back into its former position. The action of the switch gives a positive, quick break and the mechanism is of the most simple character.

THE HAZELTINE CARBON PROTECTOR.

In our issue of Nov. 12 we illustrated and described a simple device invented by Mr. C. W. Hazeltine, of the Hazeltine Electric Co., of St. Louis, for the purpose of increasing the life of the carbons in arc lamps. As then described the protector consisted of a sleeve of infusible material, which was maintained in close proximity to the tip of the upper or positive carbon, suspended from a pair of chains and maintained in its proper position by a simple pulley arrangement.

By a recent improvement the device has been consider-



The Hazeltine Carbon Protector.

ably simplified, as illustrated in the accompanying engraving. As will be seen, it now consists of the same sleeve encircling the positive carbon but supported by a ring seated directly on the negative carbon. As the latter burns away, the protector drops with it and thus constantly maintains its proper position.

Tests have shown that the life of the carbons is more than doubled by the use of the device and in its present simplified form it can be directly applied to any existing lamp.

A SIMPLE POLARITY TESTER.

Under this title we published in our issue of October 29, a note by Arthur J. Newell, describing the method of preparing paper to be used as a polarity tester, when moistened so as to conduct the current.

Referring to this, Messrs. O. Berend & Co., of London, send us a book of "Wilke's Pole Finding Paper," which is said to be in general use all over Europe and has been for the last two years. The instructions explain that when wetted the negative wire will show a red spot.

THE

ELECTRICAL ENGINEER.

[INCORPORATED.]

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GEO. M. PHELPS, President. F. R. COLVIN, Treas and Business Manager.

Edited by

T. COMMERFORD MARTIN AND JOSEPH WETZLER.

New England Editor and Manager, A. C. SHAW, Room 70—680 Atlantic Avenue, Boston, Mass.

Western Manager, W. F. COLLINS, Temple Court, 225 Dearborn Street, Chicago, Ill.

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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

VOL. X. NEW YORK, DECEMBER 10, 1890. No. 136

Truisms which one has verified for one's self out of a personal experience are apt to have a special value to the owner.—S. P. Langley.

CENTRAL STATION EVOLUTION.

A WEEK or two ago, on the occasion of the visit of the New York Electrical Society to one of the handsome new Edison stations in this city, up town, one of the speakers took occasion to drop into interesting reminiscences of the starting up of the old Edison Pearl street station, the first of its kind in the country for the distribution of currents to incandescent lights. The difference between the two stations and equipments was so great that it was almost impossible to exaggerate or over emphasize it. That old Pearl street station in its day was thought to be monstrous fine, but its design, its equipment and its practice have been so vastly improved upon by the rapid evolution of the art, that the old station and the new ones hardly seem to belong to the same decade. A century might well have intervened between them. And the curious thing is that, admirable as are these new stations, they, in turn, are to be thrown into a second place by others the erection of which will not now be much delayed.

Arc stations, too, have seen an evolution, simple as their requirements are. One of the first and largest arc stations in this city occupied a building that had been used as a soap factory. Of course it went up in smoke and fire at last, and the only wonder is it lasted so long. Not a few stations started in damp cellars or ramshackle barns, and even those which were put into decent brick buildings were generally poor in style and of ludicrously small proportions. What has been seen in at least a hundred cities is excellently described in our columns this week by Mr. A. C. Shaw, in his illustrated article on the new station at Worcester, Mass. There we find a plant that, having started in a basement, has already been twice removed and enlarged since that time, and only to-day finds itself in quarters and under conditions of capacity commensurate with the demand for electric light, power and heat.

As far as we are aware, the conduct of the business at Worcester has been excellent from the beginning. Its rapid growth alone would vindicate this, and it is not to be supposed that in Worcester any more than anywhere else would there be an appreciation of the full possibilities of the field. Yet it would be a fair matter for inquiry, as was lately suggested by Mr. Sunny, whether, had the stations at Worcester, Baltimore, Providence, New York, and elsewhere been constructed on their present lines the return on the investment would not have been larger and steadier than it has been with this frequent and costly pulling down of the old barns in order to build new.

The station at Worcester, moreover, is an interesting one in the fact that it supplies a variety of services and that in spite of its composite nature the motive power is furnished by large engines. It begins to look as though the old, and hot, discussion among electric light men, as to large and small engine units was going in favor of the big engines, not merely for arc stations or composite stations, but for those supplying simply incandescent lights. The question is still an interesting one, however, and by and by may take another turn, or may show a struggle for supremacy, on economical grounds among the various distinct types of large engines themselves.

THE ETHICS OF TRANSLATION.

WE are heartily glad to note the action of the House of Representatives during the past week in the adoption of the principles of copyright. There is now hope that the country will soon have a decent copyright law under which the foreign author may derive some benefit from the republication of his work in this country. The technical author, *i. e.*, one writing upon technical topics, is perhaps the man who will benefit most by this, for while there is not often the temptation to reprint a technical book, because of the comparative smallness of the demand, yet when the rare occasion does arise, its returns and profits are snatched away from him, the very infrequency of the opportunities making them the more eagerly watched for by those who under existing conditions have not felt called upon to pay the author so long as the law did not enforce his claim.

The American technical author, too, may be benefited by the change. A case of "piracy" that has just come under our notice causes us to hope that American work of the brain will enjoy more protection abroad than now falls to its lot. Two writers in this country spent several months upon a work on electric motors. They made next to nothing out of it, but it has gone through several editions now and has circulated widely in Europe. A German doctor seeing its merit determined to put it into German, and accordingly is bringing out the work in serial form, with the same title, the same cuts, and apparently little other matter, utterly without acknowledgment of any kind. We are informed that in getting the translation

made, he took the American book, cut off the heads of the pages, and then gave them to another German doctor, better acquainted than himself with English but not sufficiently familiar with electricity to detect the origin of the text. The translation was made in due course, but the translator, finding that *his* humble work was not acknowledged, complained to the editor of a German electrical paper of shabby treatment, and thus the little job came out. We have, thanks to our German colleague, some of the parts of the serial in our possession and have been actually able to identify page after page, though often misplaced or rearranged, with the text exactly as it stands in the American book.

Now, possibly, even copyright in an approved form may not be able to touch such cases as this, but there should not be discouragement, for the public feeling and state of mind or conscience that calls for a just copyright law will visit such acts with condemnation which while it lacks directness in immediate punitive result will be not the less severe and salutary in the long run. The man whom people know to be a thief, in any wise, but who avoids the designation only because he is for a time able to keep his indignant victims at bay and in suspense by means of the law's inadequacy or delays, gains nothing after all but an accumulated retribution.

OPEN AND CLOSED CIRCUIT TRANSFORMERS.

It is not very long ago that discussions, and in some instances acrimonious controversies, were carried on between the adherents of the continuous and alternating current systems of distribution before the electrical societies and in the electrical journals; but we hear little of this nowadays, and hence it may be taken for granted that, though later in its arrival upon the scene of practical work, the alternating current is now accepted and firmly established as a practical commercial means of distribution. With this point determined, there have, however, recently arisen other discussions relating to the methods of distributing the alternating current itself. The design and character of the transformer itself have recently given rise to an interesting controversy carried on through our columns, by Mr. Swinburne as the advocate of the open magnetic circuit type as against the closed circuit type, of which Mr. Tesla has thus far been the able advocate. Taking up the same discussion in this issue, Mr. Wm. Stanley, Jr., the pioneer in transformer work in this country, brings an additional and weighty argument in support of the superiority of the closed over the open circuit transformer. Accepting the conditions of supply as we find them in practice, that is, with large fluctuations of load, according to the time of day, Mr. Stanley points out, that while the efficiency of conversion, pure and simple, of the open circuit type may, under certain conditions and with maximum load, exceed that of the closed circuit, the nature of the former is such that the primary current varies but very little throughout the entire range of the load; whereas in the closed circuit type, the primary current is practically in direct proportion to the energy developed in the secondary circuit. Based on this fact, Mr. Stanley's argument shows that the conditions obtaining in this country, at least, are against the introduction of the open circuit type on account of the high day engine-load which would be required at the station, and for which there would be no offsetting revenue.

We do not recall having seen a full record of tests of an open circuit transformer throughout its entire load, and we think Mr. Swinburne could throw much light on the subject thus brought forward by Mr. Stanley by submitting such a record.

An Ampere-Foot Table.

There is hardly a piece of electrical apparatus which does not embody the construction of an electro-magnet, and whereas heretofore the proportions of the magnet were to a large extent a matter of guesswork, the recent advances in the study of magnetism now make it possible to determine beforehand the properties of a magnet with considerable accuracy. While in the past the calculations, especially of dynamo electric machinery, have for the most part been made and expressed in ampere turns, it is evident that when practically applied, the ampere turns have to be reduced to a given length of wire capable of carrying a given amount of current. To simplify this calculation, therefore, and in fact to make it practically unnecessary will be recognized at once as a valuable addition to the methods of the constructing electrical engineer. The table which we give in another column, calculated by Mr. L. W. Serrell, will for this reason be welcome to many of our readers.

Electric Railway Tracks.

While it might appear, upon the surface, that electric railroading differed from horse traction merely in the nature of the propelling force, experience in the new work demonstrated from the very start that certain ulterior considerations had to be fulfilled in order to insure success. Among these there is none of greater importance to the proper operation of an electric railroad than the track itself. Electric cars must of necessity be heavier than the old type hauled by horses, and when to this we add the fact that the wheels of the electric car frequently grip and grind or plane the track in addition to the old rolling motion, it is evident that heavier tracks must be provided to withstand the added strain. This has now become generally recognized with the result that the installation of an electric railroad is generally accompanied by a new and heavier rail. But there are still some points in connection with this subject which deserve careful attention and are well brought out in the article by Mr. T. H. Gibbon, appearing on another page. The present method of track construction is certainly not one embodying the greatest economy when renewal and repairs are taken into consideration, and a method in which these items are reduced to a minimum, such as that bearing Mr. Gibbon's name, must sooner or later command the attention it deserves. Again the question of ground return wires and rail-joints is one that has by no means been finally solved. The present method of construction by reenforcement with bare copper conductors, has in many instances been found to lack permanence, on account of the corrosion of the conductors by electrolysis. A rail construction which will obviate this difficulty has thus an important additional claim to recognition and it will no doubt receive the careful consideration of electric railway operators.

THE BARRIETT ELECTRIC FAN OUTFIT.

The small space occupied by the fan driven by the electric motor has made such outfits a familiar sight, and now, to bring the machine down to its most simple and effective form, Mr. S. L. Barriett, electrician of the Barriett Electric Co., of this city, has designed the type illustrated in the accompanying engraving. The little motor, which is of $\frac{1}{16}$ h. p., embodies neat electrical and mechanical designs, which constitute important advantages in practical operation.

Thus, the field magnet is laminated with the softest charcoal annealed iron, having no joints in the magnetic circuit in the direction in which the lines of force pass. By the use of a toothed armature, the teeth of which are cut spirally, all noise is prevented and the resistance of the air gap is reduced to a minimum, enabling the use of an armature of extremely low electrical resistance. The energy wasted in heat in an armature is proportional to its resistance, and is not only important as affecting the efficiency, but also in its effect upon the cool running of the

THE BARRIETT ELECTRIC FAN OUTFIT.

motor. Besides, a low resistance armature gives better regulation, and this can only be secured by using a powerful field which can be obtained when such a field is used with an expenditure of very few watts.

The electrical design has been carefully worked out. The armature and field magnets are connected in series and for the 110 volt circuits the windings are as follows: Armature, 5 ohms; field magnets, 105. The counter E. M. F. generated is equal to 55 volts, so that the machine in operation takes only $\frac{1}{2}$ ampere.

It will be noted that on account of the high resistance of the field in series with the armature the motor can be thrown into circuit without any external resistance and runs cool without the permanent interposition of such a resistance.

When running at its normal speed of 2,500 revolutions per minute, it is capable of exhausting 156 cubic feet of air per minute.

By merely adding to the number of the plates in the field and increasing the length of the armature, the $\frac{1}{16}$ h. p. motor is converted into one of a $\frac{1}{8}$ h. p. The former has a fan 8 in. in diameter, and the latter, running at 2,100 revolutions per minute, 12 inches. Mr. Barriett is now working out designs of motors of larger powers.

THE ELECTRICAL EXECUTION DELAYED.

It appears that the last proceedings in the case of the murderer Wood cause a practical stay. Hence the date of execution is again uncertain, and the apparatus will once more have to be tested in advance on some innocent animal.

A NOVEL FORM OF MEASURING INSTRUMENT.

In a recent issue of *La Lumière Electrique*, M. F. Leconte gives a brief account of some experiments carried out by him at the Liège University with a view of testing a curious form of electrical measuring instrument. M. Leconte's idea is to make a pile of circular iron discs, interposing some springy substance between each disc, and to place this pile inside a solenoid. When the solenoid is traversed by a current, the pile of discs tends to contract owing to the formation of unlike magnetic poles at the opposing surface of the discs. This contraction is resisted by the springs, and by means of a suitable magnifying device the movement of a pointer along a suitably graduated scale enables one to read off the volts or the amperes. M. Leconte employed discs ranging in number from 18 to 60, in diameter (1mm. = 40 mils) from 20mm. to 65mm., and in thickness from .2mm. to 8mm. Amongst the substances employed as springs were watch-spring steel, blotting paper, packing paper, ordinary paper, flannel and black india rubber. The tendency of the discs to move sidewise was checked by punching holes through them and slipping them over vertical glass rods. The sensitiveness of such an apparatus can be increased either by adding to the number of the discs, augmenting their surface, or by providing the solenoid with a core of iron wire. M. Leconte gives curves of the scale readings obtained with a voltmeter arranged with 18 cast-iron discs, 8mm. thick, and 65mm. in diameter, and provided first with india rubber springs and then with steel springs. The curve in the first case was fairly regular between 27 and 53 volts; with steel springs the curve was very irregular; with india rubber springs the deviation of the scale index was only 18mm. for 57 volts, and the actual contraction of the column of discs was only 2mm.; with steel springs the index deviation was only 8mm. for 50 volts.

THE NEW SOUTH AMERICAN CABLE.

The cable steamer *Silvertown* arrived at Valparaiso on Dec. 1 from London, having on board the submarine cable to be laid between Callao, Peru, and Valparaiso, Chili, for the Central and South American Telegraph Company, of New York. Soundings will be taken on the northward trip, and when completed the cable will be laid from Callao to Iquique, thence to Valparaiso. Its opening about January 1 will be followed by a reduction in commercial and press rates to all places in Chili and Argentina. Many of the restrictions, such as double charge for code messages and a fee for registration imposed by the English companies, will not be enforced by the American company.

SECRETARY TRACY ON THE ELECTRICAL CORPS.

Last week we alluded to the reference in the report of the Secretary of the Navy to the electrical corps, proposed by Lieut. B. A. Fiske. The passage, in full, is as follows:

"In connection with the subject of a naval militia, I would call attention to the advantage of providing a place in its ranks for persons of special acquirements demanded by the naval service, but of a character somewhat outside of the ordinary scope of professional training. The extensive employment of electricity in its applications on shipboard makes it necessary for naval officers to acquire a certain amount of electrical knowledge, but it is impossible for all, or even for any great number of them, to become expert electricians, nor is it desirable that they should do so at the expense of other branches of their profession of more pressing importance. To meet this want, it is suggested that a corps of naval electricians be established in the different States that have created a naval militia, to be attached to this militia and to receive the naval training which it is the great object of the militia to give.

"By this means a corps of electrical specialists would be organized, familiar with the needs and usages of the naval service, and the extended applications of electricity to naval vessels would be rapidly developed in time of peace as well as in war. In the latter contingency the corps would be especially valuable in fitting out new vessels with electrical apparatus and in taking charge of the electrical plant on board ships in commission. The number of officers available in an emergency would thus be increased, as those now detailed to electrical work could be assigned to other duties and their work could be carried on by the experts of the naval militia."

THE JEFFREY ELECTRIC COAL MINING APPARATUS.

THOUGH but a comparatively short time has elapsed since the benefits accruing to mine operators by the employment of electricity have been shown, enough has been accomplished to demonstrate not only the thorough practicability of the various types of electric apparatus, but their economy also. This refers as well to the lighting of mines as to the transportation of the product mined by electric motor cars, and its bringing down by electric drills.

Among those who have devoted considerable attention to the application of electricity to mining purposes, and especially coal mining, are the Jeffrey Manufacturing Co., of Columbus, O., who have utilized their long experience in coal mining machinery to good advantage in the new class of work. As a result, they have produced and already installed in a number of places the coal mining machine illustrated in the accompanying engraving, Fig. 2, page 650.

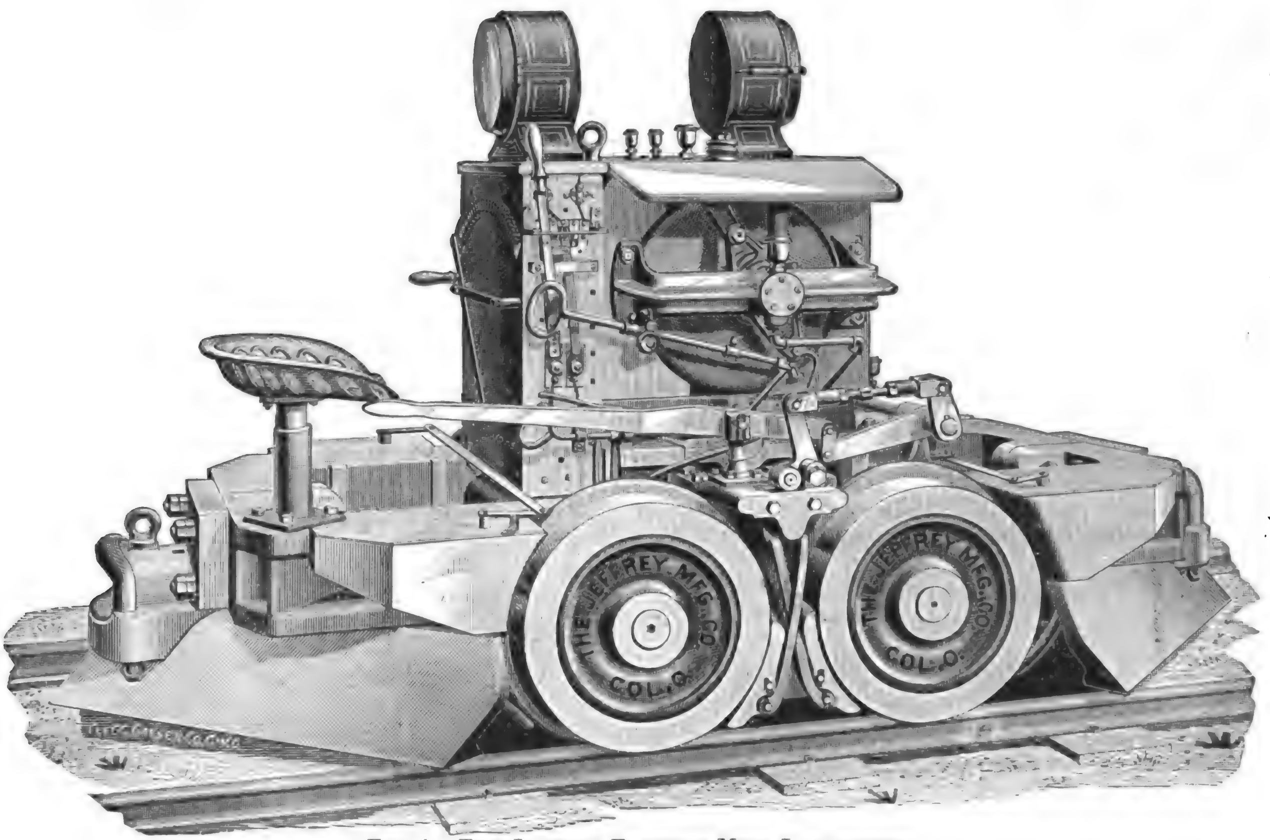


FIG. 1.—THE JEFFREY ELECTRIC MINE LOCOMOTIVE.

The machine consists of a bed frame occupying a space two feet wide, by seven feet six inches long, composed of two steel channel bars firmly braced, the top plates on each forming racks with their teeth downward, into which the feed wheels of the sliding frame engage. Mounted upon, and engaging with, this bed frame is a sliding frame, similarly braced, consisting mainly of two steel bars, upon which are mounted at the rear ends, an electric motor, from which power is transmitted through straight gear and worm wheel to the rack, by means of which the sliding frame is fed forward. Upon the front end of this sliding frame is mounted the cutter-bar, held firmly by two solid steel shoes, with brass boxes. The cutter-bar contains bits, made of tool steel, held in place by set screws. When the cutter-bar is revolved, these cutters or bits cover its entire face. The cutter-bar is revolved by an endless curved link steel chain from the driving shaft, and as it is revolved, is advanced by the mechanism into the coal or other material, to be under-cut to the desired depth.

The motor occupies a space of about 20 inches square, is built in the most substantial manner, and has an efficiency of 90 per cent. The current required is from 30 to 50 amperes at a pressure of 220 volts; each motor is wound to develop fully 15 h. p., though frequently in some veins of coal the machine only uses 30 amperes or 8½ h. p. in making cuts. The machine is started by means of a switch located on a resistance box, on the rear end of the motor.

The armature of the motor is calculated to run at a speed of 1,000 revolutions per minute, from which the speed is reduced, so as to run the cutter-bar 200 revolutions per minute. The momentum of the armature is such, that ordinary obstructions met by the cutter-bar in the coal are not perceptible, causing the machine to run steadily and comparatively quiet.

The machines are operated by two men, one man in charge and the other as helper. Trucks are furnished with the machines, which enable them to be handled with ease. The machine is taken into the mine upon this truck and run into the room to be under-cut. It is then placed on two boards in front of the coal at one side of the room, and is fastened firmly by means of the front and rear jacks, which are braced against the face and roof of the coal; this prevents the machine from moving while in operation.

The cutter, which is revolved by an endless chain, is fed forward, by means of rack and pinion wheels, to a depth of five or six feet, according to the size of the machine. The usual length of the cutter-bar is 39 and 42 inches. When the full depth has been reached the feed is thrown off, and by means of a reverse lever, the cutter-bar is withdrawn to its starting place. This completes the cut, and the machine is moved over the length of the cutter-bar used, and another cut is made in the same manner. This is continued until the entire width of the room has been under-cut, after which the machine is again loaded on the truck and taken into another room. These cuts are made on an average of from four to six minutes each.

The amount of coal under-cut, or the lineal feet face for each machine, depends upon the quality of the coal, and the skill of the men handling the machines. In some coal veins the machines have cut at the rate of 130 and 150 lineal feet face in ten hours to a depth of six feet. Twice

this amount can be cut if the machines are run on double shift.

As an adjunct to the mining machine just described, the electric drill, illustrated in Fig. 3, affords a means of driving holes at any angle and in any position.

The drill consists of a small electric motor hung in an upright frame having projections at the top and bottom, arranged with adjusting screws, by means of which it is fastened to the roof and floor of the mine. This is supported by a brace to stiffen and hold the frame rigidly while the drill is in operation. The motor is of the same type as that on their electric coal mining machine, and of a size to develop one-half h. p. It has a speed of 2,000 revolutions per minute, which is reduced by means of gearing to 100 revolutions at the feed bar. The motor is started and stopped with a simple switch, a rheostat not being necessary. The current is conveyed from the line to the drill by means of a small conductor cable. The drill can be handled by one man, and, being simple in construction, any man with ordinary intelligence can run it with a few hours' instruction.

The results of many months working have shown that by the use of the electric mining machine, a saving of from 25 to 33 per cent. can be had over hand mining with a considerable gain in marketable product, on account of the small amount taken out in the bearing-in.

To the gain in labor obtained by the mining machine, must be added the economy due to the electric haulage of the product below the surface. The Jeffrey Company have also devoted attention to this important feature and as a result have designed the electric mine locomotive, illustrated in Fig. 1. The frame of the car is built entirely of iron, thus giving it both strength and the weight required on the track for necessary traction. It is furnished with an electric motor of the same type and voltage as the mining machine, and has steel-tired wheels and axles.

Current is transmitted to the motor by means of a double trolley of four wheels, running on two conductors placed along the sides of the hauling entry, the same being made fast to the ribs of the entry. There is no rail or ground return. The armature shaft has a pinion and spur gear, direct to the axles. The motor is speeded to run eight miles per hour. The car is furnished with sand boxes and electric head lights and double brakes. The motorneer sits at one end of the car.

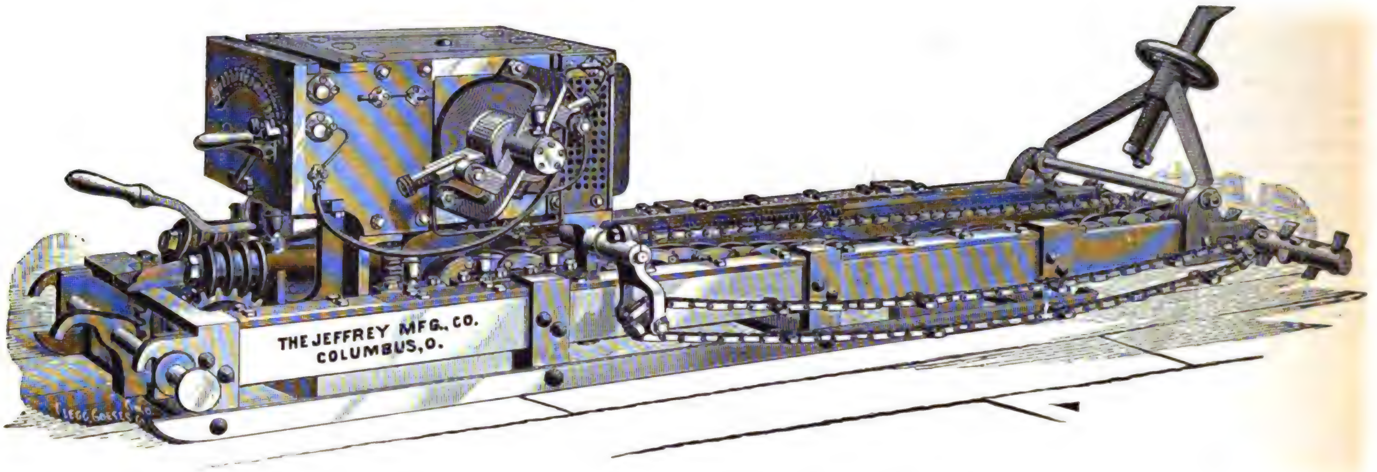


FIG. 2.—THE JEFFREY ELECTRIC COAL MINING MACHINE.

The size and capacity of the motor cars made thus far by the Jeffrey Company, have been of 20 h. p., weighing five tons on the rail. The motor car has worked on a grade against loads up to $4\frac{1}{2}$ per cent. The car is about 8 feet 6 inches long, by 46 inches high at the highest point.

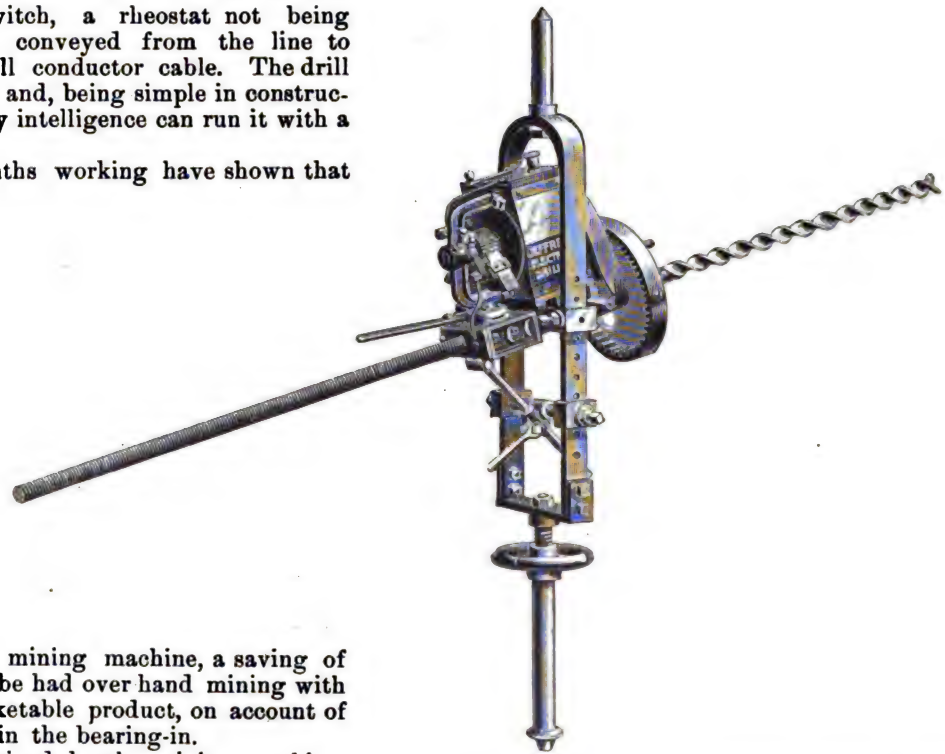


FIG. 3.—THE JEFFREY ELECTRIC MINING DRILL.

The installations made by the Jeffrey Company comprise the lighting and power equipment of quite a number of mines, including those of the Thurmond Coal Co., at Thurmond, W. Va.; the Sterling Mining Co., at Cannelton, Pa.; the Morris Coal Co., Brush Fork Mine, Hocking Valley, and a number of others. The success which has thus far attended the use of these installations will no doubt lead to their general appreciation.

"DUPLEX" RAILWAY TRACKS.

BY THOMAS H. GIBBON.

YOUR illustrations of the "Duplex" rail and lap joint system of railway construction in THE ELECTRICAL ENGINEER of Oct 29, have brought many prominent mechanical and electrical engineers, and contractors, to inspect our working model and to analyze this all-metal and simple system of railway construction; they have also brought many letters of inquiry from many states, respecting the cost of the system, and especially regarding the joint problem, and the contact of metal at the joints without wiring.

We, ourselves, are convinced that railway companies building with this system for electrical propulsion, save the expense of wiring at the joints, be it $100 or $400 per mile, which all other track systems entail to make this contact. No one doubts, who has inspected this system up to this writing (and they are numbered by scores), that a very great saving in labor in construction is effected; no one has yet doubted its absolute maintenance of gauge, and I do not think any practical man believes that there could be a low joint on this lap joint principle; that question has not once been mooted.

For the benefit of your readers, and also to answer the many inquiries, I have prepared a plan view of a joint chair, Fig. 2, showing how the girders of the rail are seated in the grooves of the chairs, and notches of the tie-bars, and all finally locked by the transverse wedge key; also, how the expansion and contraction of rails is provided for.

Of the many points of superiority which this system possesses, indicated in your article referred to above, none is more important than its "duplex" quality, and lap joint principle, for on that principle, and that only, can an absolutely jointless track be made or maintained, and upon this important feature in railway construction hangs very materially the financial prosperity of any railway company, and is the only means to absolutely make electricity the cheapest motive power that can be used, besides giving rapid transit and comfort to the traveling public.

It is a well recognized fact, that there can be no rapid transit where low and bad joints exist; it is also a recognized fact that bad joints cause rapid destruction to the rail, the motive power, the cars, and distress to the traveler. This is bad enough, but it is also recognized that electric propulsion is more destructive to the rail than any other motive power, be it steam, cable or horse—that the head of the rail is, as it were, under a planing machine, night and day, and must naturally wear out more rapidly than where the wheels only roll on the rails, as in cable or horse propulsion. This fact will sooner or later be more fully recognized, especially when two renewals of track, with all their attendant evils and expense, are to be made, instead of one, where horse or cable is used.

This is an important matter in finance, and no doubt will be seriously considered when it is more thoroughly understood that

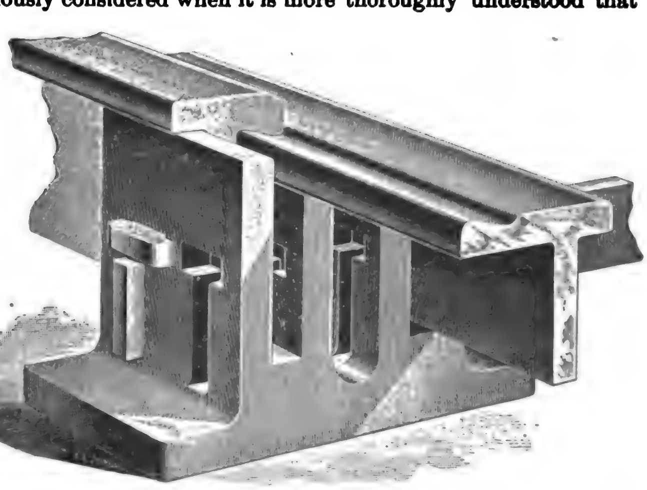


FIG. 1.—THE GIBBON "DUPLEX" RAIL CONSTRUCTION.

only about 9 pounds of head wear can be obtained from the heaviest section of rail rolled, whether side bearing, centre bearing, or grooved rail; it is sad to think that a 70 pound rail has only 9 pounds head wear (for the life of the rail is governed by the life of the head) and that 60 pounds is destined to be scrap. One renewal of such a road is equal to $1,500 per mile per annum for the life of the track, assuming that it will require eight years to wear this $\frac{7}{16}$ of an inch, and that is the utmost limit; or 9 pounds of metal of the head. This is exclusive of the repair account (of track only) which may be estimated at $300.00 per mile per annum.

The "Duplex" rail and lap joint system was designed to give longer life to the rail, by the removal of bad and low joints, by its lap joint principle. Its duplex character was designed so that either section of rail could be removed without discarding the whole, and also to give more lateral vertical stiffness to the track. The head section has all the wearing capacity of any other type, and only weighs about one-half of the whole rail; thus, at renewal, only 25 pounds per yard of scrap is made, instead of 60 pounds per yard with the single girder type, and furthermore the renewal can be made without much disturbance to the pavement.

The plan view of the joint chair shows the contact of the sides of the girders of the rail, with the inner faces of the grooves in the chairs, and also the upper and lower face of the wedge keys

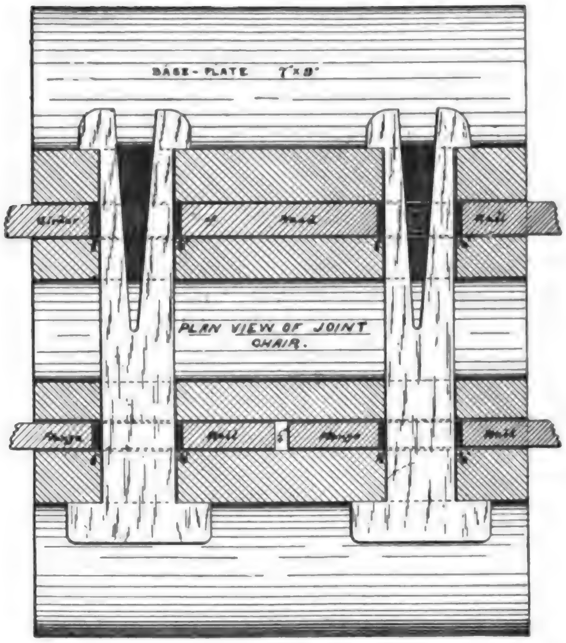


FIG. 2.—THE GIBBON "DUPLEX" RAIL CONSTRUCTION.

in contact with the top and bottom of the mortise in the girder of the rails.

The isometrical view of track at the joints, Fig. 1, shows the under face of the tram section resting upon, and therefore in contact with, the three vertical walls of the chairs; the under faces of the rails are in contact with the upper face of the solid flange rail. The under faces of the head rails are also resting upon, and therefore in contact with, the outer vertical wall of the chairs, thus making fifteen or more points of contact of metal the length of the joint chairs, instead of only two, when made by wire, the contact of which may be destroyed at any moment by the chemical action of the earth on the copper wire and steel rail. That there is a serious and detrimental action now taking place at the joint wires through the above named cause is already observed.

It is these and other kindred repeated outlays which are going to burden electricity as a cheap motive power in the future, and unless a great reduction can be made in track maintenance and renewals it is a question whether the profits are not largely swallowed up in renewal of tracks and cars.

What we have striven to accomplish in the Duplex system, and what is desired, is an imperishable track, rapid to construct, true to gauge at all times, the removal of low joints, ease of renewal and repairs, and smooth riding to the traveling public.

NEW YORK SUBWAY RENTALS.

The Board of Electrical Control met in the Mayor's office on Dec. 4. Mr. Lauterbach, for the Consolidated Subway Company, reported that the company had organized the Empire City Subway Company (Limited), and proposed, with the permission of the Board of Electrical Control, to release to it the work of constructing low-tension subways, at the same time holding itself liable to the board to do any of such work that the board might direct. The matter was referred to the corporation counsel for his opinion. The Mt. Morris Electric Light Company complained that the Consolidated Subway Company had failed to provide it with a duct in Duane street, although the Edison Company had been given one there. The Subway Company was directed to furnish the desired duct immediately.

The question of duct rentals was again discussed. The electric light companies claim that $1,000 per mile is too large a rental and are fighting against that charge in the courts. As a judicial decision in the case is expected this week, the board decided to take no action in the premises, and adjourned until Dec. 8, when the decision will guide their action.

ELECTROLYSIS OF ALUMINUM FLUORIDE.[1]

BY M. ADOLPHE MINET.

The author by continuing his researches on the electrolysis of the fused fluoride of aluminum, has been able to determine the composition of the electrolytic bath, which, for a given temperature and current density, yields the best results. The physical properties of the mixture of salts, and the relation between the current density and the constants of electrolysis, have also been found.

Composition of the Bath.—The bath is formed of a mixture of sodium chloride, and the double fluoride of aluminum and sodium. It is expressed by the chemical formula $6\ NaCl + Al_2\ Fl_6,\ 3\ NaFl$. Its fusing point is 675° C., and the temperature of vaporization 1035° C. Its electrical conductivity at the temperature $t°$ C. is expressed by the formula

$$C_t = 3.1\ [1 + 0.0022\ (t - 870°)].$$

For a current of 1,200 amperes the weight of the bath should be 20 kilogrammes, the current density should be 1 ampere per square centimetre of active surface of the positive electrode, and the voltage of the electrodes should be 5.5 volts.

The composition of the bath is maintained constant by adding a mixture of aluminum hydrate, oxyfluoride of aluminum, and the double fluoride of aluminum and sodium, by the action of which the aluminum disengaged at the positive electrode is reabsorbed by the mixed electrolyte.

Relation between the Current Density and the Electrolytic Constants.

Let V be the voltage applied to the electrodes, e the opposing electromotive force in volts due to the polarization of the electrolyte, R the resistance in ohms of the electrolyte, and C the current in amperes.

When the salts composing the bath are chemically pure, we may then distinguish three cases. In the first the current density is very small, and V and e are practically identical. If the temperature is constant, V is found proportional to C until the current density reaches an upper limit. This limit, when the temperature t is 870 degrees, varies between 0.02 and 0.03 ampere per square centimetre. Beyond this limit, and until the current density exceeds 1 ampere per square centimetre, the formula $V = e + R\ C$ holds, and the author gives several numerical results obtained from experiment and calculation. A few are appended below :—

$t = 852°$ C, $e = 2.15$, $R = 0.01$			$t = 890°$ C, $e = 2.40$, $R = 0.0044$			$t = 980°$ C, $e = 0.34$, $R = 0.0033$		
C	V Measured.	V Calculated.	C	V Measured.	V Calculated.	C	V Measured.	V Calculated.
130	3.50	3.45	196	3.26	3.26	572	4.25	4.23
245	4.60	4.60	885	6.18	6.29	1030	5.78	5.74

When the current density exceeds one ampere per square centimetre the value of V cannot be calculated as a function of C in any simple way. It rapidly attains a magnitude approximating to that required for an electric arc of 30 or 40 volts.

When the electrolyte is mixed with extraneous salts, such as those of iron or silicon, it is still true that while the current density lies between certain limits the decomposition takes place according to Sprague's law. The following numbers were obtained from experiments on a bath, from which the salts of iron and silicon were successivel y removed.

Iron present. $t = 810°$ C. $e = 0.75$ $R = 0.0093$.			Silicon present. $t = 840°$ C. $e = 1.37$ $R = 0.0089$.			Alumin'm salts only. $t = 870°$ C. $e = 2.15$ $R = 0.0085$.		
C	V Measured.	V Calculated.	C	V Measured.	V Calculated.	C	V Measured.	V Calculated.
75	1.45	1.45	65	1.95	1.95	100	3.00	3.75
225	2.85	2.85	217.5	3.35	3.31	187.5	3.75	3.25

TELEPHONY AT THE FRANKFORT EXHIBITION.

At the International Electrical Exhibition to be held next year at Frankfort, music is to play a novel and an important part. A large number of telephones will be fitted up in the buildings, by means of which visitors will be enabled to hear not only the concerts given in the Palmen-Garten, but also concerts at neighboring towns, Homburg, Soden, Wiesbaden, etc.; and it is even hoped to provide visitors with an opportunity of hearing the performances at the opera-houses of Mannheim and Munich.

1. *Comptes Rendus*, October 27, 1890.

THE CENTRAL STATION CITY PLANT AT ALLEGHENY CITY.

There is perhaps no plant in this country where so many lights are operated from such a small central station building as is the case at Allegheny City, Pa. The plant is owned by the city and it operates the alternating system exclusively, both incandescent and arc lights; and it is mainly for this reason that the company was enabled to run such a large number of lights from a comparatively small power-house.

The plant has a capacity of 4,500 incandescent and 540 arc lights. It was established last spring; and the contract for the installation of the electric light system was awarded to the Westinghouse Electric and Mfg. Co., after a severe competition.

The power house is a very handsome brick building situated near Braddock street and the tracks of the Pittsburgh, Fort Wayne and Chicago railroad. The roof of the building is graced by a beautiful tower from which the main wires are distributed. The boiler room is in the rear of the building containing a battery of six tubular boilers, each measuring 16 feet in length with a diameter of 66 inches. Slack coal is utilized as the fuel under the boilers and each of the latter are also fitted with a Roney patent stoker. The utility of this appliance has manifested itself in this plant to a very great extent from an economic point of view.

From the boiler room, a small door leads into the power house proper, the dimensions of which are 50 x 56 feet, and in this space the entire amount of the engines and dynamos for the operation of the complete plant are confined as follows: There are seven 160 h. p. Westinghouse compound engines, one 85 h. p. compound engine, two 15 h. p. automatic engines, three 1,500 light alternating current incandescent dynamos, two exciters and nine 60-light alternating current arc machines.

The switch board of both the incandescent and arc light occupies the greater portion of the north side wall in this room, containing all the switch board appliances used in connection with the Westinghouse system of electric lighting. The plant has been in operation since the fifteenth day of July last and since that time, there has never been any interruption in the service, either in the incandescent or arc light supply.

The working of the central station is superintended by Mr. David Hunter, Jr., and Mr. Maurice Coster acts as chief engineer.

The arc lights are used to light up the streets of the city. All the construction work in this direction was done by the North American Construction Co. The lights are distributed by mast arms and towers. Of the latter, the city has put up 53 with five lights on each and the rest of the lights are on mast arms.

The lights have given every satisfaction to the people of Allegheny City. Since the plant has been in operation the city has realized that the present capacity of the station is hardly sufficient to meet the demands of the entire place and an extension is already contemplated.

A LARGE ELECTRIC RAILWAY SYSTEM FOR BRIDGEPORT, CONN.

The Bridgeport Horse Railway Company, which has operated a line of horse cars since 1864, has sold out to a number of wealthy men. Among the purchasers are A. G. Yates, W. S. Kimball, the tobacco manufacturer; Frederick Cook, Arthur Luetchford, A. E. Perkins, Charles Everest, and J. N. Beckley, of Rochester, N. Y.; Edward M. Gibbs, of Norwich, Sherman H. Hubbard and Charles A. Hotchkiss, of Bridgeport. The purchase price was $350,000, about double the amount of the capital stock of the company. The purchasers of the line own the street railway lines in Rochester, Buffalo, Newark, N. J., Paterson, N. J., and other cities. They intend to extend the lines through more streets and to the suburbs of the city. When the work is completed there will be about twenty miles of the road in operation. Work on the improvements will be begun at once, and the tracks will be laid early next spring. The company intend to expend $1,500,000 in making improvements. The equipment of the road will be new throughout and electricity will be used as the motive power.

RESULTS WITH ELECTRIC ROADS IN ST. LOUIS.

Regarding the use of overhead electric wires for street car propulsion, Mr. E. V. Matlock, the supervisor of city lighting of St. Louis, writes as follows in reply to an inquiry addressed to the Mayor of St. Louis and referred to him :

The systems in use here are the Thomson-Houston, Sprague, and Short multiple systems. As far as known, no one has been seriously injured or killed by the electric railways. The people generally do not apprehend any danger from the electric railways, and the introduction of this method of transportation has almost doubled the traffic on those lines which are using it, and increased the speed of transportation about 100 per cent. over horses, and the general feeling of the residents along the lines of these electric railways, is one of great satisfaction with them.

Real estate in the western portion of the city has increased in value, in some cases over 300 per cent., and the general feeling is that it is a great improvement over other methods of travel. With a few exceptions, all the horse car lines have adopted, or are about to adopt, one of these systems, and the days of the horse car are numbered in this city.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.

Anonymous communications cannot be noticed.

The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.

In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.

Sketches and drawings for illustrations should be on separate pieces of paper.

All communications should be addressed EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

"ALIUM" INSTEAD OF "ALUMINUM."

[150.]—We have been much interested in the discussion which has been carried on through your paper and other electrical journals in reference to the proper spelling and pronunciation of the new word aluminium, and we understand that it has practically been decided to call it aluminum.

Prof. Thomson, in the course of a conversation the other day, suggested to us that while the matter was under consideration, it might be well to shorten the term and call it "alium." This impressed us as being a most excellent suggestion on account of its euphony, its ease of pronunciation, spelling, etc., and its similarity to the terms used to describe other metals, such as sodium, barium, calcium, cadmium, osmium, herbium, lithium and several others.

We have taken the responsibility of making this suggestion, although Prof. Thomson and ourselves realize fully that so great a change might involve considerable difficulty by giving rise to misunderstanding. Still, if this is to become a common metal, it seems to us that it should be about as easy to pronounce as gold, silver, tin, lead, iron or zinc.

E. W. RICE, JR., SUP'T.

THOMSON HOUSTON WORKS, LYNN, MASS., Nov. 29.

EUROPEAN CORRESPONDENCE.

LONDON.

Fire at the London Electric Supply Corporation's Central Station.—Lighting of Madame Tussaud's.—Studying Electricity in the French Navy.—Telephones in France.—Supply of Electricity in Madrid.—Tenders for Spanish Coast Cable.

THE London Electric Supply Corporation's central station at the Grosvenor Gallery was burnt down on Saturday morning. This is a very serious matter, as the company is obliged to suspend business for the present. I am enabled to give the following statement from Mr. Ferranti about this station, and how the fire occurred.

Until recently the Grosvenor station was supplying the whole of the lights of the London Electric Supply Corporation. Owing to an injunction obtained by the neighbors, the company has been obliged to abandon it as a generating station and use it only for distributing the current supplied from Deptford. It was necessary to turn out the old machinery and install that for converting purposes, which would transform the high tension to the intermediate tension for supplying to the customers. It was imperative that the stopping of the generating plant should take place on Saturday night, and the transforming plant to be ready by as early an hour on Sunday as possible. This was partly done; the whole of the work was, of course, of a temporary nature.

The accident occurred at 6:30 on Saturday morning owing to the action of a lineman in plugging on a fresh set of converters. The man hesitated in putting in the plug, and a slight arc formed. He drew it back and broke the contact. The heated surfaces together with 5,000 volts pressure maintained the arc. It ran up the woodwork and set fire to the wookwork of the ceiling and burned out the whole place in the short space of twenty minutes. The lineman had ample opportunity of entirely stopping the damage, as a switch within a yard's distance would have broken the supply through the plug switch. There was still another safeguard, had he not been too frightened, and that was the safety switch at the end of the room which would have cut off the whole of the supply from Deptford. He could also have signalled for the current to be cut off. The ammeters and voltmeters at Deptford, however, showed that something was wrong in London, and the current was cut off.

Madame Tussaud's, the famous wax work exhibition, was lighted for the first time to-day by electricity.

The Great Northern Telegraph Company is about to lay a new direct cable between the west coast of Jutland and Calais.

By reason of the increasing importance of electricity to the navy, the minister for the French navy has just arranged for the instruction of the staffs of the arsenals in electrical science. He has decided that two foremen and two workmen, electricians, shall be sent to Paris from each French arsenal to study the working of the electric light. Lectures on the theory and practice of electricity will be given to naval officers at the observatory of Paris on and after the present date. They will last during four months and will be given every Thursday and Friday.

An agreement has been made between the government and the municipality of Argenteuil by which a telephonic line shall connect that city with Paris. M. Jules Roche, minister, has just submitted a decree to the President, which reduces the subscription to an overhead telephonic system to 150 francs in cases where the population does not exceed 25,000 inhabitants. This regulation comes into force on the first of January, 1891, in the case of towns already provided with a system, the number of whose subscribers does not exceed 100.

English and German companies in Madrid are now actively engaged in laying down wires for the supply of electric light in houses and business establishments. The German company has received orders for 11,000 lamps and the English company for, perhaps, as many as 6,000 lamps. The former can supply 22,000 lamps without using accumulators and 40,000 if they use Tudor's, as it is their intention to do. The streets in Madrid are now much broken up during the laying of the wires, and the public, though favorable to the electric light, shows some impatience with the present state of the streets. The English company have plenty of ground available on which they may enlarge their station for their alternating current supply. The German company, with their continuous current, have their cables only in the centre of the town and contemplate erecting two other stations outside. Both companies maintain the high price of 14d. to 15d. per unit.

Two tenders have been sent in for the laying of the cable between Spain and the African coast. One is from the India Rubber Company and the other from an Italian firm. Both tenders are in accordance with the conditions published by the government, but the chances are much in favor of the English proposal being accepted.

H. S.

LONDON, Nov. 19, 1890.

CORRESPONDENCE.

CHICAGO.

Amendments in the Chicago Club Constitution.—Marriage of George A. McKinlock.

AT the last meeting of the club, held at its rooms, 103 Adams street, on Monday evening, December 1st, the following amendments to the constitution and by-laws were adopted:

Changing Article III, Section 1, to read as follows: Resident members shall pay an entrance fee of Fifty dollars, and annual dues of Forty dollars.

Article III, Section 2—Non-resident members shall pay annual dues of Twenty dollars.

Article III, Section 3—Non-resident members becoming resident members, must pay the entrance fee.

Article III, Section 4—The financial year of the club shall commence on the first day of April of each year.

Article IV, Section 2—The president or one of the vice-presidents shall preside at all meetings of the club; in their absence a temporary presiding officer may be elected.

Article IV, Section 6—At all meetings of the board of managers the chairman shall preside; in his absence a temporary presiding officer may be elected.

Article IV, Section 6—To be numbered Section 7.

Article VII, Section 1—Resident members only are entitled to vote at any regular or special meetings of the club; and they must vote in person.

Article VII, Section 2—No member who is in arrears for dues shall be entitled to vote at any meeting or election.

Mr. E. F. Browne then read a highly instructive and carefully compiled paper on "Electricity in Mines and the Proposed Mining and Electrical Display at the World's Fair." A lively discussion ensued which was participated in by Messrs. Bain, Badt, Goodman, Armstrong, Cutter and Browne.

Mr. George A. McKinlock, the popular and genial treasurer of the Central Electric Company, was married Tuesday evening, December 2nd, to Miss Marion Rappleye, at the residence of Mr. Rappleye, No. 3,636 Prairie avenue. The ceremony was conducted by Bishop Cheney, and was solely a family affair, none but the members of the two families and immediate relatives being present. After the ceremony, Mr. and Mrs. McKinlock left for New York, from which city they sailed on Saturday on the steamship "Etruria" for a year's tour in Europe. I desire to congratulate them and to unite with their many friends in wishing them every happiness. Messrs. W. L. Candee, Geo. Manson and Durant Cheever, of the Okonite Co., have sent them a most beautiful and

useful present in the shape of a complete set of silver table ware, consisting of eighty-nine pieces, with monogram on each, in an oak case. The staff in the office of the Central Electric Co. have also remembered Mr. McKinlock and presented a very handsome field glass, which he will no doubt use with much pleasure during his sojourn abroad.

CHICAGO, Dec. 5th, 1890.

BOSTON.

Rules for Motor Men.—Work for Inspector Flanders.—The Meigs Elevated Road.

GENERAL MANAGER MONKS, of the West End Railway, has issued the following order to motor men on electric cars:

"You are hereby notified that you must not hold conversation with any passenger while on duty on your car. If passengers wish to engage in conversation with you, tell them, politely, that you are not allowed to talk with them, as your time and attention must be fully occupied in the careful operation of the car."

Since Mr. B. S. Flanders has been appointed and confirmed inspector of electric wires, there has been some curiosity on the part of the fire commissioners to know whether the new ordinance took the control of the fire-alarm telegraph out of their hands, and placed it in the hands of the new inspector. It is the opinion of the corporation counsel that the wires and apparatus of the fire-alarm system should be under the control of Mr. Flanders, but that considerable time will have to elapse before Inspector Flanders will be able to arrange all the details. The question is a nice one, and exactly where the dividing line will come in it is impossible yet to tell.

At a meeting of the board of aldermen, an order was passed that $12,556.77 be transferred from the appropriation for fire department, the said sum to constitute an appropriation for the department for the inspection of wires.

The committee on railroads reported leave to withdraw on the petition of the Meigs Elevated Railroad Co. for location on certain streets.

BOSTON, Dec. 6, 1890.

PITTSBURGH.

Progress in Electric Railroads.—Lighting the Public Buildings.—Track Lighting for Steam Railroads.

THE Knoxville Incline Company, of this city, is erecting an electric light plant for the purpose of illuminating the entire track of the incline from Mount Oliver down the hill to the foot of South Thirteenth street. The plant will be in operation within a few weeks, and it will not only illuminate the hillside very brilliantly, but it will also be a great blessing to the people who are now obliged to climb the hill during the night in utter darkness. The company hopes also to avoid accidents by the lighted condition of its line.

A number of the cars of the Duquesne Traction Company have now arrived in this city, and they are being equipped with electric motors at the company's power house. It is expected that the first trip will be made during Christmas week.

The Cambria Iron Company is now engaged in the manufacture of the street rails for the tracks of the Troy Hill Electric Street Railway line in Allegheny City. The poles are now being put up, and as soon as the rails arrive the roadbed will be laid as quickly as possible. The management of the railway hope to have the cars running in two months at the latest.

The secretary of the treasury has recommended the appropriation of $15,000 for an electric plant to be utilized in the illumination of the new Pittsburgh Custom House and the Post Office building. In addition to that he has also recommended the appropriation of $185,000 for an electric lighting plant for the new public building in Allegheny City.

The stockholders of the Second Avenue Electric Street Railway Company held their annual meeting a few days ago. They elected a new board of directors and officers for the ensuing year, and they also received the report of the treasurer. The latter showed that the company had earned during the first nine months of the year $23,227.65 net.

One of the most practical schemes for the utilization of electric lighting is now being introduced by the Pennsylvania Railroad Company. In considering ways and means towards the alleviation and decrease of accidents to life and property on their lines, the management has decided to establish electric lighting stations at such places along their system of tracks, where the traffic is so large as to be of constant danger to the traveling public and the employés of the company. The first trial is now being made from Frankford Creek to Torresdale, a distance of 11 miles. If this experiment proves satisfactory the company intends to light up the entire track from Philadelphia to New York City.

PITTSBURGH, Dec. 5, 1890.

FINANCIAL MARKET.

QUOTATIONS ON ELECTRICAL STOCKS.

F. Z. Maguire & Co., Electrical Securities, of 18 Wall street, this city, report the following quotations of December 6, from New York, Boston and Washington; Pittsburgh, December 5.

NEW YORK.

	BID.		BID.
W. U. Tel. Co	74	Edison Gen. Elec. Co	70
American Tele. & Cable	83	Edison Gen. Co. Def'd	....
Centl. & So. Amer	155	Consol'd Elec. Lt. Co	...
Mexican	210	Edison Illn'g Co. N. Y	68
Com. Cable Co	....	U. S. Elec. Lt. Co	30
Postal Tel. Cable	39	North Am. Phonograph	30

BOSTON.

	BID.		BID.
Thomson-Houston	39	Ft. Wayne Co	10¼
" Pref'd	25¼	Am. Bell	[illegible]
" Series C	....	Erie	[illegible]
" " D	5¼	New England	[illegible]
" Int. Co	....	Mexican	.05 cts
Thomson Welding Co	....	Trop. American	..
Thomson Eu. Welding	....	Edison Phon'gph Doll	1¼

WASHINGTON.

	BID.		BID.
Penna. Telephone	25	U. S. Elec. Lt (Wash)	139
Ches. & Pot. Telephone	....	Eck.&Sold. Home Elec. Ry.	57¼
Amer. Graphophone	11¼	Georgetown & Tenallytown	47

PITTSBURGH.

	BID.
Westinghouse Electric and Manufacturing Co	16½

BURNING UP OF AN EDISON ORE CONCENTRATION PLANT.

A special despatch from Marquette, Mich., of Dec. 4, says:—"The experimental station erected by Thomas A. Edison at Humboldt, thirty miles west of Marquette, for the purpose of concentrating low grade iron ores by electricity was destroyed by fire last night. The fire began in the engine house. The building was valued at about $7,000 and contained two dynamos and much valuable machinery, all of which is ruined, making the total loss not less than $12,000. There was $5,000 insurance.

"The station was established two years ago. Although no information was given to the public regarding the success of the experiments, it is generally understood that Edison's process was proving successful. At the time of the fire preparations were being made to ship a car load of ore which had been raised from 50 to 71½ per cent."

A NEW TELEPHONE EXCHANGE FOR ALBANY.

The Hudson River Telephone Co. has asked the permission of the Albany City Council to put its wires in that city underground. Mr. A. B. Uline, general manager, says that the company are negotiating for a site on which a handsome granite fire-proof building will be erected for the telephone exchange. In all the parts of the city where the wires and poles look unsightly and are in the way, the company desires to remove the poles and lay the wires underground. This improvement will probably be made in that part of the city bounded by North Ferry street and the Lumber district on the north, Second avenue on the south, Swan or Lark streets on the west and the river. The conduits will be laid through the streets included within these limits, and communication with them will be through manholes at every intersection of streets. The conduits will contain about 20 lead covered cables, each cable containing 50 pairs of wires.

The company desires to obtain the permission from the Common Council as soon as possible, but will probably not begin laying the conduits until next spring, as pavements could not be relaid properly during the winter.

MR. JOHN N. STEWART, the new president of the Ohio State Tramway Association, is an old military telegrapher, who was assigned to duty in the vicinity of Washington, D. C. After the war, he closed the circuit telegraphically with the golden spike and silver mallet when the great railroads across the continent made their junction at Promontory Mountain. Since then he has been prominent in a number of enterprises.

LIGHT AND POWER FOR RAILWAY SHOPS.—The order recently placed by the Union Pacific system, for lighting the shops of the Denver Union Railway & Terminal Co., at Jersey, Col., with the Western Isolated Lighting Department of the Thomson-Houston Electric Co., comprises two 500 light dynamos and other appliances, including wiring, necessary to operate 1,100 incandescent lamps; also a 600 light generator which will be used in connection with an electric motor for running a transfer table.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The next meeting of the Institute, to be held at the house of the society, 12 West 31st street, at 8 p. m., on Tuesday, Dec. 16, promises to be very interesting. Mr. A. E. Kennelly will present a note on "Inductance and its Proposed Unit, the Henry," and Mr. Emile Berliner will read a paper on "The Perfected Gramophone," with illustrations and experiments. The machine will be exhibited, on this occasion, for the first time in New York City. Members are invited to bring ladies.

NEW YORK ELECTRICAL SOCIETY.

This society is doing admirable work, and its next meeting, at 8 P. M. on Wednesday, Dec. 10, promises to keep up the high standard. A paper is to be read by Mr. E. P. Thompson, the well-known patent expert and attorney, on "How to Make Great Inventions; or, Inventing as a Science and an Art." The meeting is to be held at the Socy. of Mech. Engineers, 12 West 31st Street, and as a general invitation is extended, a very full house may be expected. The subject is one of the utmost interest and importance.

DINNER AT THE NEW YORK ELECTRIC CLUB.

The December meeting of the club was celebrated by a dinner, for which no fewer than 75 covers were laid. An excellent dinner was served by Club Steward Stadler. After dinner, speeches were made by Mr. Erastus Wiman, Mr. Joseph Howard, the famous newspaper correspondent, now of the New York *Press;* Capt. Zalinski, who bade the club farewell, as he was leaving for duty on the Pacific Slope; Mr. T. C. Martin, Mr. Foster Coates, of the *Mail and Express;* Mr. P. H. Alexander, and Mr. Adams, of Boston. Mr. Howard was also prevailed upon to tell how, in his early days, while attending to the movements of the Prince of Wales in Canada, he had telegraphed large blocks of Biblical genealogy to New York, in order to prevent a rival from getting the use of the wires. Mr. F. Z. Maguire also enlivened the evening by playing an original composition, "Valse Electrique," on the piano. The festivities were kept up until nearly midnight, and a most delightful and successful evening was spent.

THE CITIZENS' ELECTRIC CO.'S BALL IN BROOKLYN.

Between 200 and 300 people, officers and employés of the Citizens' Electric Illuminating Co, of Brooklyn, and their friends, gathered at Saengerbund Hall, Brooklyn, last Friday, and "tripped the light fantastic" to the music of the latest popular airs, the occasion being the fourth annual ball of the Employés Mutual Benefit Association. Dancing commenced at 10:30 o'clock and continued until a late hour, supper being served during intermission. The proceeds of the ball will be added to the fund already in the treasury of the Benefit Association. Among those present were J. Supple, B. Rush, E. Reynolds, J. R. Barefield, E. F. Peck, T. H. Brady, of Brady mast arm fame, E. D. Cook, Supt. of the Brooklyn Edison Co., W. H. Barstow, Gen. Mgr. of the Brooklyn Edison Co., John Birkett, W. H. Bowne, Chief Engineer of the Citizens' Co., James Ferguson, Supt. of the Municipal Electric Light Co. of Brooklyn, Frank Mason, Supt. of Police Telegraph, and Hon. John Delmar. To Mr. Reynolds, Secretary of the Association, great praise is due, on account of his untiring efforts to make this affair the deserved success that it was. Everything went smoothly, evincing careful forethought and the best of management. THE ELECTRICAL ENGINEER speaks of the ball's brilliant success from personal observation.

AMERICAN CONTROL OF THE NEW PACIFIC CABLE.

There are strong arguments for participation by the United States Government, says the Worcester, Mass., *Gazette*, in the plans for a trans-Pacific telegraph cable to connect the coast of the continent with Samoa, Hawaii, and Australia. The President has just urged Congress, in his Message, to take action to prevent the mail-carrying Pacific steamships from changing the American terminus of their voyages from Australia and the Pacific islands from San Francisco to Vancouver, in British Columbia. Senator John H. Mitchell, of Oregon, now urges Congress to take a hand in the plans for a cable under the Pacific, and predicts that the cable will certainly be soon laid, and that if the United States holds aloof from the project, the cable will be laid under British and Canadian auspices, and its eastern terminus will be in British Columbia. Men of affairs in the Northwest have special reasons for knowing and appreciating the dangers of allowing the ports of British Columbia to gain steamship advantages over the United States Pacific ports. They and the President make these dangers clear to the people of the rest of the country. They have a strong line of argument in the evident social, political, commercial and military value there would be in a Pacific cable landing within United States territory.

REPORTS OF COMPANIES.

STOCKS AND BONDS.

HANNIBAL, MO.—A special popular vote was taken on Nov. 25, on the proposition to issue bonds to the amount of $20,000 to increase the power of the city electric light plant and to put in an incandescent plant. The proposition was carried, with the necessary two-thirds majority and 144 votes to spare.

MACKAY'S PURCHASE OF THE BANKERS' AND MERCHANTS' COMPANY.

A deed was recorded at Washington, on Nov. 28, by which W. N. Armstrong, of New York, as referee, conveyed for a consideration of $890,000 to John W. Mackay, of Virginia City, Nev., all the rights, franchises and privileges of the Bankers' and Merchants' Telegraph Company, the Bankers' and Merchants' Telegraph Company of New Jersey, the Bankers' and Merchants' Telegraph Company of Pennsylvania, and the Bankers' and Merchants' Telegraph Company of Indiana, including the lines of the company from Washington to New York.

OUTPUT OF AMERICAN BELL TELEPHONE INSTRUMENTS.

The Bell Telephone Company makes the following favorable statement of instruments for the month ended the 20th of November:

Month Nov. 20.	1890.	1889.	Increase.
Shipments	5,318	3,763	1,555
Returned	2,926	2,929	*3
Net output	2,392	834	1,558
Since Dec. 20.	1889-90.	1888-9.	
Shipments	59,105	52,157	6,948
Returned	25,241	22,827	2,414
Net output	33,864	29,330	4,534
Instruments in use Nov. 20	478,725	440,871	37,854

*Decrease.

PROPOSED ISSUANCE OF WESTINGHOUSE PREFERRED STOCK.

With regard to the announced intention of the Westinghouse Electric and Manufacturing Co. to issue $3,000,000 of preferred stock, the directors of the company have made an official statement, in which they say: "The difficulty in raising new money for carrying on the increasing business of the company and carrying terms has, owing to the stringency in the money market, been very considerable, and it has been finally decided, after a long discussion, that the only practical manner in which to provide for the wants of the company is to exercise the power conferred by its charter of issuing preferred shares, and a meeting of the stockholders has been called for this purpose. A proposition will be submitted to the stockholders to authorize the directors to issue the remaining $2,000,000 of authorized increase, and to convert a total of $3,000,000 of the $10,000,000 into preferred stock, the preferred stock to be entitled to a dividend of 6 per cent. in preference to the common stock, and this dividend to be accumulative, and these shares to share equally in the profits when the dividends are more than 6 per cent. on both the common and preferred stock. The management expects to have its subscriptions completed by the time of the meeting to enable the company to carry on its business in a comfortable manner. The recommendation to create preferred stock was adopted unanimously after full discussion and after consultation with parties having a considerable interest in the company. It is believed that these shares will find a ready market as soon as people are in a position to make investments, and that the extinguishment of the debt of the company by the issue of the preferred shares will at once advance all of the shares of the company to the position they should occupy by reason of the very large business which the company is doing. These preferred shares are to be sold at par, and it is proposed to have the interest payable July and January."

A stockholders' meeting was called for this Wednesday, Dec. 10.

THE ELECTRIC CAR CURE FOR RHEUMATISM.

One of the latest crazes in St. Louis is that of riding upon the electric cars to cure rheumatism, and hundreds of victims of the dreaded affliction who have borne their sufferings in silence are now eagerly seeking for information and testing the new cure. "It is amusing to see passengers on our line eyeing each other and whispering to companions about the new cure for rheumatism," remarked a Union Depot Line conductor, laughingly. "If a man, woman or child boards a car with a crutch or cane you can hear whispers to the effect that there is a rheumatic patient out to test the new cure."

LEGAL NOTES.

PIKE ELECTRIC CO. vs. RICHARDSON DRUG CO.—CLAIM FOR WIRING DONE.

The action was brought to recover a reasonable value for labor and material used in putting in an electric light plant in the drug company's house on the corner of Fourth street and Clark avenue, St. Louis. Before the plant was completed the house burned, and the Electric Company sued for what they claimed was due them under the contract. The plaintiff company obtained a judgment for $1,700 in the Circuit Court, but on appeal, the judgment has been reversed and the case remanded.

HYDE PARK DIST. TEL. & ELEC. CO. vs. CITY OF CHICAGO.—POLE LINE PRIVILEGES.

The Hyde Park District Telegraph and Electric Company has secured an injunction from Judge Horton restraining the city of Chicago from removing complainant's telegraph poles and interfering with the placing of wires over the territory formerly known as Hyde Park. In February, 1889, the trustees of Hyde Park granted a franchise to complainant to erect poles and lay wires in any street and alley in Hyde Park on getting consent from a majority of property owners abutting such route. When the village was annexed to Chicago the telegraph company asked the Commissioner of Public Works for authority to erect new poles and this was denied, as the city ordinance requires all wires to be located underground. The company, however, insists that it has a right to string wires on new poles under the ordinance passed by the village trustees. The city will move to dissolve the injunction.

A DECISION AGAINST THE SINGLE TROLLEY IN OHIO.

A decision was rendered in the general term of the Superior Court at Cincinnati, on December 2, against the use of the single trolley system on the Mount Auburn electric road. The Mount Auburn Co. has given notice of an appeal to the Supreme Court of the State.

BRUSH ELECTRIC CO. vs. SPRAGUE ELECTRIC RAILWAY AND MOTOR CO.

In the suit of the Brush Electric Company against the Sprague Electric Railway and Motor Company for alleged infringement of patent, the defendent company has filed an answer in the office of the Clerk of the United States Circuit Court. In this answer all the allegations in the bill of complaint are generally denied. It is also averred in the answer that the letters-patent granted to Charles F. Brush are void and of no effect, principally because the improvements or inventions claimed by him are described in previous letters-patent granted in this country and Great Britain prior to his alleged invention, and because, it is asserted, Elihu Thomson, and not Brush, was the original inventor of the alleged improvements.

A TELEPHONE COMPANY'S REFUSAL TO PAY STATE TAXES.

Vice-Chancellor Bird, of New Jersey, has refused the State's application for an injunction to restrain the Pennsylvania Telephone Company from doing business in New Jersey. The application was made because the company refused to pay $3,648 taxes, which they said was on business done partly in this State and partly in adjoining States, and therefore came properly under the head of Inter-State commerce. The company's line runs from Scranton, Pa., to New York, passing through New Jersey. In refusing the injunction, the Vice-Chancellor, however, adds, that he does not set aside the assessment, as this is a proper subject not for chancery, but for a court of law.

INTERSTATE TEL. CO. vs. B. &O. TEL. CO.—AN ACCOUNTING REQUIRED.

The Interstate Telegraph Company has filed a bill in the United States Court, at Baltimore, against the B. and O. Railroad and the B. and O. Telegraph Company.

The bill alleges that the complainant recovered recently a judgment against the Baltimore and Ohio Telegraph Company for $25,000 and costs, which it has been unable to collect, and prays for a receiver of the B. and O. Telegraph Company, and that the railroad may be required to account to the creditors of the telegraph company for so much of the $4,000,000 received by it from the Western Union Telegraph Company as may be necessary to satisfy the claims of the complainant and all other creditors who may come into the case.

LEGISLATION IN BEHALF OF TELEGRAPH OPERATORS.

The telegraph operators throughout the State of Georgia are endorsing the bill introduced in the State House of Representatives on November 26, by Representative Boifeuillet. The following is a testimonial handed to him on Nov. 27, upon his arrival in Macon :—

"We, the undersigned telegraph operators of Macon and vicinity, hasten to express our utmost solicitude for the speedy passage of the bill introduced by you in the house to-day, prohibiting railroad companies in Georgia from employing any telegraph operator under eighteen years of age, and who has not had at least one year's experience as an operator. Speaking from experience, we are in full sympathy with the bill.

"It is an indisputable fact that nine-tenths of the terrible railroad disasters attributable to telegraph operators in America are directly traceable to inexperienced and grossly ignorant and incompetent boy operators. And we hold that travel is seriously imperiled on any road where such service is permissible.

"In thus tendering our endorsement of your measure, we faintly voice the earnest sentiment of the fraternity, not alone in Georgia, but throughout the United States. The names hereto appended were all subscribed within an hour's time."

This is followed by a long list of names.

WESTERN UNION OBJECTIONS TO TELEPHONE WIRES.

The Western Union Telegraph Company has refused to allow the New England Telephone Company to string its wires alongside the Boston & Maine tracks in Danvers. An effort is now being made to get the needed permits from those who own the land next to the railroad. This will probably be successful, and the difficulty removed.

MUNICIPAL LIGHTING PROPOSED FOR WHEELING, W. VA.

A brisk discussion is going on at Wheeling, W. Va., as to a municipal lighting plant, and all the old arguments from Dunkirk, Ypsilanti, and elsewhere, to show that municipal plants are economical, are being used as though they had never been exploded and shown to be utterly wrong, deriving fallacious conclusions from widely inaccurate figures. The Wheeling Electrical Co. stands ready to furnish lights at $75 or $80 a year, and the city council will be level headed if it closes a contract at that figure.

THE PRESIDENT ON GOVERNMENT TELEGRAPHS.

The following passage from the message of President Harrison to Congress relates to the use of the telegraph by the government: "The use of the telegraph by the post-office department as a means for the rapid transmission of written communications is, I believe, upon proper terms, quite desirable. The government does not own or operate the railroads, and it should not, I think, own or operate the telegraph lines. It does, however, seem to be quite practicable for the government to contract with the telegraph companies, as it does with the railroad companies, to carry at specified rates such communications as the sender may designate for this method of transmission. I recommend that such legislation be enacted as will enable the post-office department fairly to test by experiment the advantage of such a use of the telegraph."

WORCESTER GAS AND ELECTRIC COS. NOT ALLOWED TO CONSOLIDATE.

The petition of the Worcester Gas Light Co. for authority to engage in the business of generating and furnishing electricity for light and power, which means a consolidation of that company with the Electric Light Co., has been dismissed by the State board of gas and electric light commissioners. The commissioners state in brief that there is no call for a consolidation of the two companies, and that the public would derive no benefit from such a consolidation.

EDISON LAMP PRODUCTION.

It is stated by the Newark *Call* that the new buildings which have been added to the Harrison Lamp Works of the Edison General Electric Co. are completed and will be ready for occupancy in about two weeks. Two hundred additional hands will be employed, and the output of lamps, stimulated actively by the recent reduction in price, will be increased to 25,000 per day.

A CITY ELECTRICAL INSPECTOR FOR NEW ORLEANS.

The city authorities of New Orleans have lately been busy considering questions of pole lines and the insulation of wires. The matter of appointing a city electrician has also been discussed, and the fire and lighting committee proposes that the official to hold this position shall draw a salary of $1,200.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED DEC. 2, 1890.

Alarms and Signals ;—

Electric Clock-Alarm, M. W. Tiedemann, 441,906. Filed June 27, 1889.

Alarm clock has one of its legs removably arranged in an open circuit and a key rotating with the alarm mechanism, together with an electric connection with which the key makes contact closing the circuit and sounding an alarm.

High-Water Alarm, I. H. Simpson, 441,962. Filed May 19, 1890.

For tanks and water-towers. A discharge pipe placed at high-water mark discharges into a spring-supported bucket which actuates an electric circuit-closer operating an alarm.

Annunciator, F. E. Fisher, 442,029. Filed July 7, 1890.

An annunciator for indicating either of two words or numbers as "in" or "out." Mechanical device for amplifying the movement of a pointer beyond a range conveniently obtained by the electro-magnet.

Conductors, Conduits and Insulators :—

Machine for Covering Wires, Cables, etc., and for Making Tubing and Cord, V. Royle and J. Royle, 441, 808. Filed Aug. 30, 1890.

Third claim follows :

The combination with the head of a press for covering wires, cables, or other bodies or making tubing of a die laterally adjustable relatively to the core, and a core which is adjustable in an axial line or lengthwise relatively to said die, substantially as herein set forth.

Conduit for Electric Conductors, E. T. Greenfield, 441,837. Filed Dec. 14, 1889.

The tube or conduit has a body of insulating material and a continuous protecting skin or envelope of a less inflamable material, which latter may be metallic, if desirable.

Attaching Device for Electric Conductors, E. T. Greenfield, 441,838. Filed Mar. 3, 1890.

A flexible metal strip having a hole about midway of its length for securing it to a wall or ceiling by a nail or screw, and an eye at one end and a tongue at the other to serve as a lock or fastening when the strip is bent around a tube or conduit.

Process of Impregnating Porous Bodies, E. T. Greenfield and J. Nagel, 441,839. Filed May 9, 1890.

Method of treating fibrous, porous or cellular bodies, applicable for use in electrical tubes or conduits.

Underground Conduit for Electric Wires, E. T. Greenfield, 441,840. Filed May 27, 1880.

A conduit system for underground wires embracing man-holes, hand-holes, and junction-boxes for distribution. Conduit consists of a trough, preferably rectangular and made of wood treated with waterproofing and preservative material ; wire-ways formed within the trough of compound tubes of high insulating properties ; the tubes are held in position at certain distances apart by uprights attached to the base-board of the trough, the tubes are supported away from the bottom of the trough, and when desired in successive tiers, by cross pieces, the ends of which lie in grooves in the opposite side of the trough. An insulating material in a fluid state is poured into the trough and allowed to harden after the wire-ways or tubes are fixed in position.

Process of Working High-Boiling Hydrocarbons for Impregnating Purposes, E. T. Greenfield and J. Nagel, 441,870. Filed Feb 25, 1890.

Applicable to tubes or conduits for electric wires. Consists in maintaining the hydrocarbons in a liquid condition by heat and adding from time to time a lower boiling hydrocarbon or equivalent to supply the volatile matters evaporated.

Electric Wire-Coupling, W. E. Banta, 441,919. Filed June 11, 1890.

Consists in a series of rings surrounding the jointing wires and adapted to retain the full strength of the metal composing them and to bite the harder upon the jointing wires the greater the stress : the rings may be connected together by a bar secured to them along the line of the jointing bars.

Dynamos and Motors :—

Regulator for Electric Motors, W. E. Hyer, 441,665. Filed Oct. 10, 1889.

A mechanical device located between the load and the motor and operated directly by the former. The pulley transmitting the power from the motor is connected with the motor shaft through a coil spring and a sliding block feathered on the shaft. The sliding block has a cam-surface which bears against a similar cam-surface on the pulley. The rotation of the pulley is opposed by the spring, the amount of lost motion allowed by the spring, through the effect of the load, determining the distance which the sliding block moves longitudinally on the shaft. The movement of the sliding block may be utilized in any way desirable, as for example, switching in or out resistance, to effect the regulation.

Brush-Holder for Electric Motors or Dynamos, W. S. Patterson, 441,695. Filed Aug. 20, 1890.

Design and construction of yoke and brush holder. Invention consists in details of construction.

Dynamo-Electric Machine, W. K. Freeman, 441,793. Filed Sept. 20, 1890.

Design and construction for simplifying and improving alternate current dynamos, consists chiefly in details of the armature construction.

Regulator for Dynamo-Electric Machines, W. K. Freeman, 441,794. Filed Sept. 20, 1890.

Hand regulation. Horn-shaped pole-pieces of field magnets, embracing the armature, are pivoted so that they may be expanded away from, or contracted towards, the periphery of the armature by means of a screw and hand-wheel.

Motor-Regulator, D. Pepper, Jr., 441,807. Filed Oct. 1, 1890.

First claim follows :

The combination of a resistance-box connected at one end with a circuit, a switch arranged as specified to complete the circuit through said box, and by progressive movement cut out resistance until at the end thereof the box is cut out, a second switch arranged to connect with the circuit as the first switch severs connection with the resistance-box, and automatic means for moving said second switch over the resistance-box in the circuit, all substantially as and for the purpose specified.

Electro Motor, H. Groswith, 441,953. Filed Aug. 13, 1889.

Reversing mechanism for electric motor, for changing the direction of rotation of the armature ; applicable to motors of the class having two sets of coils upon the armature and two commutators.

Method of Operating Electric Motors, H. Groswith, 441,954. Filed Mar. 5, 1890.

Claim 2 follows :

An electric motor having a set of field-coils, armature coils, and commutator in one circuit, a duplicate set of elements, a common external connection to one brush of each commutator, and a pair of contacts or binding-posts connected respectively to the two other brushes for external connection.

Lamps and Appurtenances :

Incandescent Lamp Fixture, F. Lewis, 441,877. Filed Aug. 9, 1890.

Pendant attachments to the key of incandescent electric lamps.

Electric Arc Lamp, T. P. C. Crampton, 442,018. Filed July 14, 1890.

Claim 1 follows :

In an electric arc lamp, the combination with a pair of differential solenoids and adjustable stops, of an upper carbon-holding tube, having at its upper end a tubular iron core sliding in the solenoids and provided at its lower end with spring-clutch jaws acted on by the adjustable stops to release the carbon, substantially as described.

Guard for Incandescent Electric Light Globe, J. Mino, 442,071. Filed Feb. 27, 1890.

A wire guard similar to that employed upon lanterns.

Galvanic and Thermo Electric Batteries :—

Galvanic Battery, A. H. Hoy, 441,843. Filed May 26, 1890.

Construction of cell and elements specially applicable to dry batteries.

Galvanic Battery, C. G. de Peralta, 441,967. Filed May 23, 1890.

Zinc and carbon electrodes separated by blocks of insulating material and bound together : a metallic containing vessel, and a paste containing an active and a deliquescent material surrounding the electrodes.

Miscellaneous :—

Electro-Thermostatic Valve, L. Bell and F. H. Root, 441,817. Filed July 5, 1890.

Claim 1 follows :

The combination, with a fluid-controlling valve, of a volatile-fluid chamber having a diaphragm connected to the valve and adapted to operate the latter, and an electric circuit including a resistance for heating the volatile fluid, and a circuit-closer, substantially as described.

Electric Line-Hook, F. M. Locke and J. Lapp, 441,849. Filed Sept. 8, 1890.

The opening through the hook is large enough to permit a knot or splice to pass through it freely ; arms on each side of the hook to which the wire may be tied ; the shank of the hook is flattened or cut away on one side, the more readily to permit pouring melted sulphur into the insulator around the shank after the insertion of the hook.

Apparatus for Electroplating, W. J. Possons, 441,892. Filed Oct. 18, 1889.

Devices for facilitating the manipulation of articles to be plated ; a combination of circuit-closers and the clamping devices to hold the work so arranged that the current used for electroplating will be shunted around an empty clamp while the circuit through the filled clamps will be maintained intact.

Apparatus for Electroplating, W. J. Possons, 441,893. Filed Oct. 21, 1889.

Devices for reducing the cost of manipulating electric light carbons and other similar articles while electroplating them, through the substitution of machine work for hand labor. In connection with plating tanks a system of track-ways, trucks and clamps for handling the work to be electroplated.

Apparatus for Electroplating Carbons or Other Articles, W. J. Possons, 441,894. Filed Oct. 17, 1889.

Similar in purpose to the above. Apparatus for charging comprises a series of tubular holders and an adjustable hinged rack constructed with grooves for holding and guiding the articles to the holders.

Rheostat, T. K. Ames, 441,918. Filed Sept. 15, 1890.

Claim 1 follows :

The combination, in a regulating-switch, of a spool and a resistance-coil wound thereupon, one head of the spool carrying the resistance-terminals and the other head of the spool constituting the base or back plate whereby the switch is secured to a wall or other surface, substantially as specified.

Electrotype, W. T. Barnum, 441,920. Filed May 5, 1890.

Design and construction of electrotype block.

Thermal Out-Out, D. J. Cartwright, 441,933. Filed April 26, 1890.

Consists in the arrangement, between the terminals of a fusible wire of a cut-out, of plates of an infusible and non-conducting material, through or around which the fusible wire passes in a zigzag direction. Object: to interrupt the arc that may be formed upon the melting of a fused wire. Attains the same object by the alternative method of making perforations in plates of non-conducting materials interposed between the terminals of the fused wire and through which perforations the fused wire passes, bars or plates of infusible or non-conducting material being pivoted to the fixed plates through which the wire passes, above each perforation, so as to fall by their own weight and close the perforation when the fused wire has melted.

Electrical Indicating Apparatus for Linear Measure, J. Rapieff, 441,972. Filed Mar. 13, 1889.

Claim 1 follows:

The combination, in a range-finding instrument, of two telescopes or alidades having a linear movement with relation to each other, one or both thereof bearing electric contacts, conductors parallel with the path of movement of the telescopes upon which the said contacts act to determine a fractional included portion, and electrical circuits or branches of a circuit, one of which includes said fractional portion, another of which includes a measureable resistance-equalizer, by which linear measurements are indicated.

Electrical Location and Range Finding Instrument, J. Rapieff, 441,973. Filed March 10, 1890.

Claim 3 follows:

The combination of two telescopes or alidades movable at variable angles to a given base-line bearing a definite geographical relation, and a range and location indicator consisting of a plane table and map, independent indices intersecting to represent the vision-lines of the telescope and movable at variable angles to a given base-line bearing a corresponding definite relation to the map, and electrical transmitting apparatus, substantially as described, for synchronizing the movements of the indices with those of the respective telescopes.

Method of Finding the Range of Distant Objects, J. Rapieff, 441,974. Filed March 10, 1890.

Claim 1 follows:

The method of finding the range of a distant object, which consists in first determining a fractional portion of an electrical conducting body, which fractional portion bears in length a ratio to the variable base of a triangle included between two lines of sight converging at a constant angle upon a distant object, and second, measuring the electrical resistance of said length.

Indicator for Range-Finders, J. Rapieff, 441,975. Filed March 10, 1890.

Claim 1 follows:

The combination, in a range finding instrument, of two telescopes or alidades, both movable at variable distances apart, and an indicating device consisting of two movable adjacent parts connected, respectively, to said instruments, and an indicating scale or dial common to both said movable parts, upon which the variations of distance between the instruments are indicated irrespective of the position of such instruments with reference to a fixed point.

Lightning-Arrester, J. J. Wood, 441,999. Filed July 14, 1890.

A thermic device is arranged in sufficiently close proximity to the plates of a lightning arrester to cause it to be heated by an arc between the plates, and the consequent expansion of the thermic device is utilized to set in operation an arc rupturing device. The thermic device is located out of the path of the lightning discharge so as to preserve it from injury thereby.

Device for Utilizing the Water-Power of Falls, C. J. Zeitinger, 442,000. Filed April 19, 1890.

Device for utilizing waste water power for driving dynamos or other machinery.

Electric Switch, F. E. Fisher, 442,030. Filed July 7, 1890.

A hand switch with bell-crank lever.

Railways and Appliances:—

Electric Signaling System, J. W. Riggs, 441,703. Filed Sept. 12, 1889.

To prevent the derailment of trains when a drawbridge is open. Devices mounted on the drawbridge and in electrical connection with the track rails and insulating conductor, by which when the draw is open the circuit between a battery on an approaching locomotive and the track rails and the insulated conductor will be closed, operating an alarm or other signal in the locomotive cab.

Trolley-Stand, W. L. Emmett, 441,753. Filed Sept. 18, 1890.

For electric railways. To secure a variable and regulated pressure of the right degree upon the trolley pole in various positions. The trolley pole is attached, in opposite directions, to extensions on a pair of rocking levers, the rocking levers having a battery of springs connected between other extensions thereon.

Trolley-Covering for Electric Railways, H. Jones, 441,764. Filed Sept. 13, 1890.

The conducting rail is located above the ties and is protected by a shield covering its top and sides continuously, the side protection extending below the rail; the trolley-rod is bent into a U-shape bringing the trolley upon the top of the conducting rail under its protecting shield.

Gearing and Motor-Supporting Mechanism for Electric Locomotives, F. Mansfield, 441,771. Filed April 8, 1890.

The motor is supported entirely upon the car body and attached to it by jointed or swinging members. The gearing consists in the combination, with a car wheel axle, of a drive shaft pivotally swung to the axle so as to revolve about it, and a flexible connection between the armature shaft and the drive shaft, such as linked or other belting. Intended to relieve the speed-reducing gearing of the great stress incident to the sudden starting of the motor.

Automatic Electric Railway Signal, R. O. Owen, 441,773. Filed March 18, 1890.

Provides an automatic telegraphic railway signal by which the passage of a train past each station or section of track may be automatically signaled to the train dispatcher's office. A main line circuit is grounded at each station, or section of track, through contact springs or brushes carried upon the trains. The contacts at each station or section are spaced to represent the numbers assigned to such stations or sections.

Trolley-Wire Hanger or Support, E. H. Kitfield, 441,800. Filed March 12, 1890.

The hanger consists of two members, one of which attached to an insulator, is provided with arms to engage the trolley wire on its upper side, while the second member, provided with a longitudinal groove or channel to receive the wire, is secured and fitted into the first member. Designed to obviate the use of solder.

Electro-Magnetic Traction-Increasing System, M. W. Dewey, 441,828. Filed Aug. 25, 1890.

Electro-magnetic apparatus located along the line of railway where grades are heavy. Electro-magnets, with their cores in contact with the rails, distributed at intervals along a railway at points where it is desirable to increase the traction.

Moving Contact for Electric Railways, A. W. Adams, 442,003. Filed Dec. 28, 1889.

Contact or trolley consists of an endless belt or flexible band of conducting material passing over two pulleys supported upon the trolley pole, and moving by frictional contact with the conductor, being held against the conductor by a yielding pressure.

Secondary Batteries:—

Electrode for Secondary Batteries, J. Y. Bradbury and F. J. Stone, 441,818. Filed Nov. 16, 1889.

Electrode comprises a plate of supporting material having its opposite faces formed into alternate projections and depressions for the reception of active material. The opposite sides of the depressions are open, and laterally adjacent projections open into each other. The plate is preferably formed of strips of supporting material arranged side by side and each offset alternately in opposite directions, forming receptacles for the active material.

Secondary Battery, C. W. Kennedy and H. Groswith, 441,958. Filed Apr. 7, 1890.

Relates to secondary batteries of the class in which the active material is held in place by and between perforated plates of lead or other material, two of the plates, with the active material between them, constituting one electrode.

Claim 3 follows:

An electrode for use in a secondary or storage battery, composed of two perforated plates of lead or analogous material, having outwardly projecting knobs or studs integral with the plates, and inwardly-projecting annular raised burrs or bosses encircling the perforations and filled with active material confined between the perforated faces of the plates and raised flanges along the inner edges of the plates, substantially as shown and set forth.

Electrode for Secondary Batteries, C. W. Kennedy, 441,959. Filed June 28, 1890.

Claim follows:

An electrode for electric batteries, consisting of two or more plates of rigid metal coated on both sides with metallic lead, said plates being connected together with an intervening space filled with active material, and provided with apertures for the passage of the exciting liquid, substantially as described.

Telegraphs:—

Telegraph Circuit, F. W. Jones, 441,847. Filed June 24, 1890.

Designed for use in a main telegraph office where local circuits and branch office wires are supplied with current from dynamos, storage batteries or other similar sources, and to facilitate speedy connections between the sending and receiving apparatus in main and branch offices; also, to facilitate the easy and rapid connection of single Morse circuits with quadruplex or duplex circuits so that the messages may be automatically repeated between such circuits; also provides means for connecting the local circuits and apparatus of one duplex system with the local circuits and apparatus of another duplex system so as to permit an automatic transmission of messages from one system to another simultaneously.

NEW YORK CITY LIGHTING BIDS.

At a meeting of the Gas Commission, Dec. 4, Mayor Grant, Comptroller Myers, and Commissioner Gilroy being present, the bids for lighting the city with electricity for the year 1891 were opened. There were six bidders, as follows: The Brush Electric Illuminating Company 299 lamps at 43 cents and 45 cents; United States Illuminating Company 309 lamps at 43 cents; East River Electric Lighting Company 247 lamps at 44½ cents; Mount Morris Electric Lighting Company 171 lamps at 43 cents; Harlem Lighting Company 211 lamps at 43 cents and 50 cents; North New York Lighting Company 28 lamps at 50 cents.

Comptroller Myers offered the following resolution: Whereas, The prices named in the bids or estimates are excessive, Resolved, That the interests of the city demand that each and every bid be and is hereby rejected.

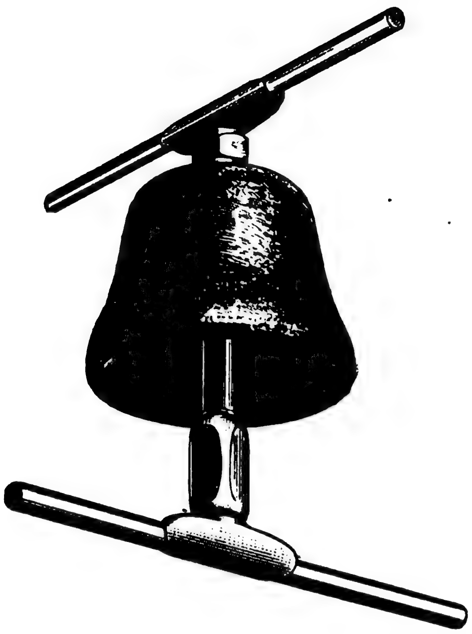
Commissioner Gilroy moved to table the resolution until the bids had been formally tabulated. Mayor Grant said that the motion was unnecessary. The bids would be tabulated before any action would be taken. The Commission then adjourned. All the bids received are from two to three cents higher than last year.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

ANOTHER FORM OF THE GOULD AND WATSON TROLLEY LINE WIRE INSULATOR.

WE illustrated in our issue of November 22nd a new form of clip, manufactured by the Gould & Watson Company, of Boston, for use on trolley line insulators. This week we illustrate another form of the same kind of clip as applied to a bell insulator. As will be seen, the clip is used both for the span wire and trolley wire. The bell, with the span wire clip, is first made fast to the



NEW GOULD AND WATSON TROLLEY LINE INSULATOR.

span wire by means of the bushing, and then the trolley wire is inserted into the bottom clip, and by means of the nut, which has a right and left hand thread, it is securely fastened in its place. The action is extremely simple and effective, and it can be applied to any line with the greatest ease.

THE CROSBY ELECTRIC CO.

The Crosby Electric Co., of 87 and 89 South Fifth avenue, this city, have purchased the business of the Federal Electric Co., heretofore carried on at 10 Cedar street, together with the stock and patents under which their goods are manufactured. They will fill all orders at once. The Crosby Co. have also received the highest award given by the American Institute Fair just closed, for all the batteries that they manufacture. It will be remembered that the Crosby Co. had a very fine and interesting exhibit at the Fair, illustrative of the great variety of uses and work to which their batteries could be applied.

ACTIVITY OF THE RAE ELECTRIC RAILWAY SYSTEM.

The Detroit Electrical Works are in a most active and bustling condition, owing to the large number of orders they are receiving for Rae electric railway equipments. During the past month they have been fortunate enough to secure a contract for fifteen 30 h. p. equipments mounted on Taylor trucks, for the Aurora, Ill., street railway lines, and they anticipate seeing the road started a day or two before Christmas. They have also contracted for the equipment of the Springfield Electric Railway & Improvement Co.'s road at Springfield, Mo., with ten complete equipments, mounted on Sheffield trucks. Last week Dr. Everett, president of the Lake View and East Cleveland, O., Road, ordered two complete equipments on Sheffield trucks for use on that road, the order being given after a thorough test of 60 days' practical running. This week they have received an order from the Joliet Ill., Street Railway Co. for a complete equipment, with Bemis truck, for use upon their existing electric road. It is stated further that the new company in Kansas City, Kan., has decided to put in the Rae system; while inquiries from all parts of the country are most numerous and pressing.

LARGE WESTINGHOUSE ORDERS.

The Westinghouse Electric and Mfg. Co. completed, during November, a month of business which has been one of the largest in the history of that corporation. The company shipped an aggregate of incandescent alternating current light machines of 80,000 sixteen candle power lamp capacity. Among the places where the Westinghouse system has been installed are Philadelphia, Pa., 750 incandescent and 300 arc lamps; South Omaha, Neb., 750 lights; Ballston, N. Y., 750 lights; Lima, O., 1,500; Aspen, Col., 750; Wellsburg, W. Va., 500 incandescent and 25 arc; Charleston, W. Va., 750, increase; Portland, Oregon, 100 arcs.

W. H. GORDON & CO.

The above firm, of 115 Broadway, have lately taken the general selling agency for the new and popular Star Electrix switches, sockets, cut-outs, etc. These specialties have but recently been put on the market, and have already made a name for themselves.

Mr. W. H. Gordon has just reported home from a week's trip in the West. While there he closed a contract with the Louisville Electric Light Co. for over 60 miles of Simplex T. Z. R. wire. Part of this, it is understood, is for the electric railway circuits and part for the circuits to carry the new Wood arc lights.

ROBINSON RADIAL CARS.

Of the Robinson radial cars ordered by the West End Railway Company, 14 of the car bodies are already completed and 35 more are well under way. The radial trucks for these car bodies are beginning to arrive at the central power station, and within a few weeks a large number of the radials will be running in the streets of Boston. The car bodies are 25 feet long, and will comfortably seat 17 to 18 passengers on a side. The height of the car bodies will be the same as in the radials now in use, that is, seven inches lower than the eight-wheel cars.

Col. George Truesdell, president of the Eckington & Soldiers' Home Railway, Washington, D. C., recently made some careful scientific tests with one of the Robinson radial cars having a 26-foot body, which he has on his road, and he states that in climbing grades the radial requires, on an average, two h. p. less than the ordinary four-wheeled cars. This is corroborative of the facts observed in connection with the running of the radials in Boston.

RAW HIDE PINIONS FOR ELECTRIC CARS.

In his recent annual report to the stockholders of the West End Street Railway Co., of Boston, President H. M. Whitney in alluding to the wonderful results obtained with the electric cars remarked that " the noise of the motors seems to be the greatest objection." There is vast improvement being made in this respect, however, and the Electric Merchandise Co., of Chicago, claim that the objection can be entirely removed by the use of their raw-hide pinions. They have already supplied about 75 electric roads with these pinions with uniformly excellent results. They are in receipt, for example, of the following letter from Mr. E. G. Connette, the superintendent of the United Electric Railway Co., of Nashville, Tenn.

" We have used your raw hide pinions and are very well satisfied with them; while the life of a raw hide pinion is not quite so long as a good bronze pinion the saving on the iron gear makes them quite economical. You will remember we purchased some of your pinions about five months ago, some of which are still in service. I have to-day sent you an order for 4 dozen."

THE CLARK ELECTRIC CO. AWARDED THE HIGHEST MEDAL.

The Clark Electric Company, Corbin Building, 192 Broadway, N. Y., received on November 29th, a special silver medal for their automatic safety device, awarded by the judges of the American Institute. The factory of the Clark Company was visited by them, and the safety device tested by cutting the electric wires and allowing them to fall on other wires; and in every instance the device proved its efficiency by removing all danger. The Clark Company have also received from the same source a Medal of Superiority for their arc lamp, run from incandescent current circuit, one of which was on exhibition at the American Institute Fair, and was much admired by visitors, being mounted in a very handsome and ornate fixture. The company are introducing this style of fixture for interior lighting for stores, theatres, public halls, etc. They have a lamp so mounted at present in their office, 192 Broadway, running from incandescent current. Mr. Clark, the electrician of the company, is an indefatigable worker, and is a fertile genius in inventing new and useful electrical apparatus.

THE BARRIETT ELECTRIC CO.

This company has just been organized to build the dynamos and motors of Mr. S. L. Barriett, well known in the electric motor field. They will start by placing on the market the smaller sizes designed for fan work, which will be followed by the larger. The officers of the company are E. L. Moody, president; J. U. Hoey, secretary and treasurer; and S. L. Barriett, general manager and electrician. The offices of the company are in the Equitable Building, N. Y., room 32.

NEW OFFICES OF THE INTERNATIONAL OKONITE COMPANY (LIMITED).

The almost general adoption of electricity for commercial and household uses, has made the demand for telegraph, telephone and electric light insulated wires and cables a large and steadily growing one. This has naturally given a decided impetus to the business growth of concerns engaged in the manufacture of such goods. In no case is this more noticeable than in the rapid progress of the International Okonite Company (Limited), of New York and London.

The new factory of the International Okonite Company (Limited), at Passaic, N. J., being practically finished and in tip-top running order, this enterprising and progressive concern have turned their attention to improving their New York headquarters, 13 Park Row, both in facilities, appurtenances and appearance. By the acquisition of three or four more rooms in addition to those formerly occupied by them, they have secured every facility for the systematic and expeditious carrying on of their immense business and have located themselves in quarters which should please the most fastidiously inclined.

The new offices of the company, richly artistic in all their fixtures, have an air of refinement and propriety in their elegance, which prevents any idea entering the visitor's mind of display in decoration solely for the sake of show. Everything is elegantly serviceable. As you step from the elevator at the fourth floor of the building, 13 Park Row, you are landed immediately in front of the entrance to the company's quarters. A door opened, ushers you into a reception or waiting room. Here one makes known his business with the company before he can proceed further. This reception room is artistically and comfortably furnished. In the centre is an immense table of finely carved and polished oak, on which are scattered in pleasing confusion, the latest issues of all the electrical journals. They are at your service if you care to peruse them. Comfortable, leather cushioned oak chairs and an oaken settee—a very artistic piece of work—complete the furnishing, and make the time you may be detained here pass pleasantly. The offices of the Okonite Company comprise six sections or departments, formed by partitions and artistic oak railings. These partitions are in themselves the main decorative features of the suite of offices, being of highly polished carved oak, the upper portion of dull glass, and surmounted with a decorative miniature railing or cornice. All the woodwork is of oak, also the furniture. Having passed muster at the hands of the office manager, Mr. Hodgkins, who, through a window placed in a partition at the rear end of the reception room, is the inquisitor, the caller proceeds to the inner or office proper.

The private offices of Capt. Willard L. Candee, Mr. Geo. T. Manson, Mr. H. Durant Cheever and the sales agent's quarters are at the further end of the reception room and on its left, as you enter. The general sales agent, Mr. T. McCoubray, and assistants, occupy an oblong room which forms a sort of hall between the private and general offices. They are replete with every facility for the convenience of those here located; desks, chairs and incandescent light; in fact the offices of the company are lighted throughout by electricity. At one end of this hall or room, is stationed the safes, telephone cabinet (a very ornamental and useful piece of furniture) and steam radiator, over which hangs the office clock. At the farther end, screened by a nicely arranged portiere and railing, is the wardrobe and lavatory.

To the left of this department and facing the busy thoroughfare, Park Row, are the private offices of Capt. Candee, Mr. Manson and Mr. Cheever. They comprise most of the space occupied by the old quarters of the company. These rooms are well lighted, equipped with desk, chairs and cabinets, of finely carved and highly polished oak. Appropriate pictures in oak frames decorate the walls, and a quiet elegance pervades the whole. Taken separately or collectively they are in every way fitted for the convenience and comfort of the well-known personages who will hold undisputed reign in their precincts. Communication from each of these offices is made to the departments presided over by Messrs. Hodgkins, Brumley and Ashton, by means of push buttons and speaking tubes, all of which allows the great business carried on by this concern to be done expeditiously and without noise or confusion. The financial or business part of the Okonite Company offices is located at the further end of the reception room, and on its right as one enters, a finely wrought oaken railing separating this department, of which Mr. Hodgkins is the head and leading spirit, form the rest of the office. Once past this gentleman's desk, which is situated at the entrance, you notice the admirable and comfortable arrangements made for the working force of clerks, bookkeepers, stenographers, etc. There is a place for every one and everything. Communication between the several departments here represented and Mr. Hodgkins are made very complete by the aid of push-buttons and speaking tubes.

The International Okonite Company in their present quarters may safely lay claim to an office which, in point of convenience and elegance, cannot be surpassed by any of its size in the city, and such an office as a firm of their commercial importance fully deserve.

THE HEISLER ELECTRIC LIGHT CO.

The proprietors of the Heisler system of long distance series incandescent electric lighting have found it necessary to transfer the manufacturing of their apparatus from St. Louis to their new and commodious works located at Gloucester, New Jersey, where with enlarged space at their command, and increased facilities, they will be enabled in the future to meet the constantly increasing demand for their apparatus. In announcing this, they say:—

"The extensive introduction and adoption of this system within the past two years for commercial, street and alley lighting, has made it necessary to increase the manufacturing facilities. It is now a recognized fact among those most interested in incandescent installations, where it is necessary to distribute lights over large areas, that the Heisler system is the only one that fully fills the requirements. The Heisler system's merits are fully recognized and acknowledged to thoroughly overcome these very serious conditions by making it possible to distribute any number of lights, from 160 thirty-two candle power lamps to the full capacity of our largest dynamos, over an area of territory that could only be covered by 50 miles of No. 8 B. & S. gauge wire, and suffer no drop in the candle power of the lights, the lamps farthest away burning as brightly as those nearest the dynamo, and the loss due to the resistance of the line (8 B. & S.) being equal only to one 32 c. p. lamp per mile. The efficiency of our dynamo under these conditions makes it possible to obtain 6¼ thirty-two candle power lights per mechanical horse-power expended, less the friction load of the dynamo, producing a white and brilliant steady light, superior to the incandescent lights usually produced by other systems. The improved automatic regulator used in connection with this system controls and maintains a steady and uniform light, and at the same time dispenses with all translating devices in the station and upon the circuit. The only device (other than the dynamo) used in the installation of the Heisler light is the improved combined automatic cut-out and lamp socket, a perfect device in itself, being adapted to hold any size lamp from 10 up to 150 c. p., containing no parts liable to get out of adjustment, and the cut-out feature is always accessible for removal without the liability of interrupting the circuit while manipulating the same. The housing of the socket is composed of insulating material and the cut-out can be renewed at a cost of less than one cent. We continue a St. Louis agency where there will be kept on hand a supply of lamps and materials for repairs, as well as immergency experts, whose duty it will be to look after the various installations west of the Mississippi river."

All orders and communications should be addressed to the Heisler Electric Light Company, Drexel Building, Philadelphia, Walter S. Smith, general manager.

THE RILEY ELEVATED SYSTEM.

It is stated that negotiations have been concluded as the result of which there will be an elevated road built between the two exposition depots of the World's Fair, at Jackson Park and Lake Front, Chicago. The Riley Co., of Boston, is to build and equip the road, which is estimated to cost about $450,000 per mile.

THE ELECTRICAL SUPPLY CO., CHICAGO.

The following circular has been issued by the Electrical Supply Co., of Chicago:—"Owing to the fact that much of our catalogue matter has at various times been copied into publications by other electrical companies, we deem it necessary to call attention to the fact that our catalogues are thoroughly covered by *copyright*, which fully protects all the descriptive matter, and cuts of articles, as well as the general arrangement of both. This being the case, anyone who reproduces our catalogues by photographic process or otherwise, so that the duplicates appear as in our original books, infringes our copyright and lays himself liable to legal action in consequence. We have justly won an enviable reputation as the producers of carefully compiled electrical trade catalogues, and in justice to ourselves, we cannot consent to an infringement of our legal business rights without a protest."

ELECTRIC GAS LIGHTING CO., BOSTON.

The above company have just issued a circular as to the Bubier battery compound, which they handle, made by the Bubier Mfg. Co., of Lynn, Mass. It is sent out in neat boxes, in sizes to make 1 pint, 2 quarts, or 4 quarts of solution. It is intended especially for Grenet, medical and bichromate plunge batteries.

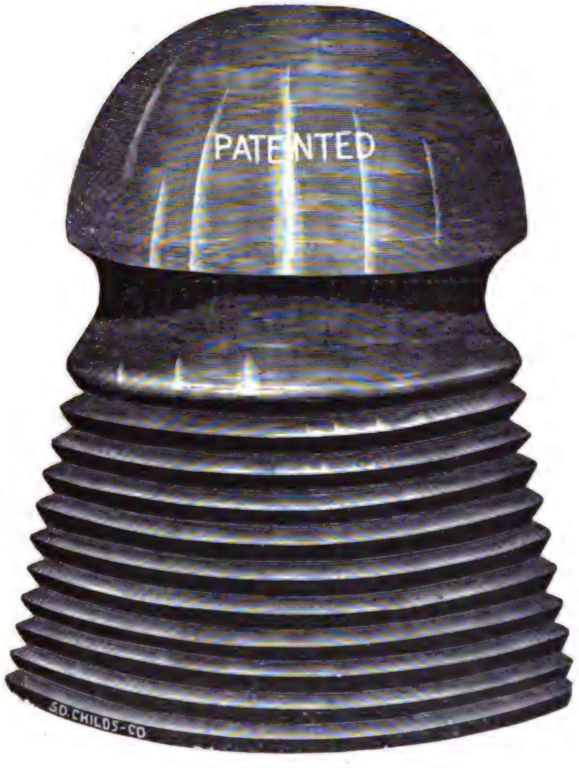
THE BAIN INSULATOR.

We present this week a cut of a new high resistance glass insulator, the invention of Mr. Foree Bain, of Chicago.

The insulator is made extra strong and is especially adapted to heavy work, such as carrying large primary wires, and particularly feeder wires for electric railroad work. The corrugations which are made both outside and inside of the apron increase the distance from the wire to the pin fully 100 per cent., and it is claimed that water will, in passing over the edges of the rings, become thin and broken, and on reaching the inside of the glass will drop off rather than creep over the inner obstructions to the pin.

Another point in favor of this form of insulator is that the many surfaces will reflect the light under the glass in such a way as to keep insects out, obviating a source of much annoyance where plain dark glass is employed.

This insulator will cost a little more to manufacture than the



The Bain Insulator.

ordinary plain glass insulator, but the inventor claims that an advance of a few cents per mile in the cost of construction will not be any objection where a high class of work is desired.

Mr. Bain has assigned his patent to the Central Electric Company, of Chicago, who are now sole owners and by whom the article is being placed upon the market.

THOMPSON, REED & CO.

Thompson, Reed & Co., 31 Liberty St., this city, is the name of a new engineering concern. The gentlemen composing it have been connected with the development of the electrical business for some time, and have the benefit of experience. They will contract to build street railways of any system, and to act as consulting engineers.

CONSOLIDATED ELECTRIC STORAGE CO.

Arrangements have been made with the North American Phonograph Co., whereby they are to use exclusively the storage battery made by this company, of 120 Broadway. This means a good deal, when it is taken into account that the North American Co. have 35 sub companies in different parts of this country, and that new ones are being formed every day.

ELECTRIC LIGHT CONE REFLECTORS.

We illustrate on this page some of the devices recently brought out by the American Reflector Co., of Fifth and Cherry streets, Philadelphia, in the line of reflectors for electric light purposes. The diffusion of light scientifically is not an easy problem, and the value of a good reflector in creating soft and steady, yet strong, effects is not as fully realized as it might be. One design is

Fig. 1.—Reflector for Clusters.

a silvered glass reflector to fasten on a ceiling, to be used with a single incandescent light. Fig. 1 shows a silvered glass reflector for clustered incandescents, it being intended to serve specially for lighting show windows, stores, offices, etc. Fig. 2 shows one of their suspended silvered glass cone reflectors, as arranged for incandescent lamps. This is made with the double cone, as shown,

Fig. 2.—Silvered Glass Cone Reflector.

and the light is therefore greatly enhanced in brilliancy and effectiveness. The company have also adapted their corrugated silvered glass head light, so that it can be utilized for electric cars, with incandescents run from the trolley circuit.

ELECTRIC CARS IN SAVANNAH, GA.

The electric cars in Savannah, Ga., began running on Nov. 3, and the conductors had a delightful time of it. Every one of the four cars was jammed, and 5,000 nickels were turned in to the company that night.

THE DEMAND FOR EUREKA TEMPERED COPPER.

The Eureka Tempered Copper Co., of North East, Pa., report large shipments of commutator segments in November to the Edison General Electric Co., the Westinghouse Electric Co., the Brush Electric Co., the Wenstrom Consolidated Dynamo and Motor Co., the Electro-Dynamic Co., and nearly all the manufacturers of motors in the United States.

At a meeting of the North West R. R. Club, held at Union Depot, St. Paul, Nov. 7th, Mr. C. F. Ward, M. M., of St. Paul and Duluth road, in the discussion of the best methods of locomotive side rods, said that he wished that some member would try tempered copper as a material for brass with solid rods. He had used the copper on some cross heads, the engine was turned out last June, and had been running ever since without any perceptible wear on the gibs.

The Eureka Co. were awarded the John Scott medal by the Franklin Institute, of Philadelphia, at the November meeting. The company report large orders received from their goods for electrical purposes and for bearings, and have been compelled recently to double the capacity of their plant.

CARD ELECTRIC DYNAMO AND MOTOR CO.

In order to acquire the increased facilities rendered necessary by their increasing business, this company is moving its works into a new building, corner Second and Plum streets, Cincinnati.

Among recent installations of the Card Co. may be mentioned a 150-light plant in the Argonaut cotton mill, Covington, Ky.; a 75-light plant in the works of MacNeil, Urban & Co., the safe dealers, of Hamilton, O., and also a 75-light plant in the factory of the Cincinnati Spring Co., of Cincinnati.

ELECTRIC CARS POPULAR IN INDIANAPOLIS.

Among the signs of the popularity of the electric cars in Indianapolis it is mentioned that they have affected hack hiring.

"Business is dull since the electric line was completed," said a livery-stable man.

"What's the relation between the two?"

"Why, people take their rides on the electric car—go to the parks and have all the outing they care for at ten cents (round trip). That beats two or three dollars. But the board bills at livery stables are about as large as heretofore."

WESTERN SALES OF THOMSON-HOUSTON APPARATUS.

The Western Isolated Lighting Department of the Thomson-Houston Co. has sold plants as follows: Democrat Printing Co., Madison, Wis., 100-light incandescent; L. E. White, Greenwood, Cal., 30 arc light; St. Louis, Mo., R. R. Co., for power house and car barns, 400 incandescent; G. F. Culmer & Bros., Salt Lake City, Utah, 100 incandescent, to be used in connection with a plant for lighting an office building as sold some months ago.

THE SHAVER FACTORY VISITED BY FIRE.

On December 2 a fire occurred in the factory of the Shaver Corporation, at 78 and 80 Cortlandt street. The damage done was of limited amount, reaching about $3,000, mostly on telephones and Gillette magneto bells, together with about 2,000 of the ingenious Shaver spiral screw drivers. The company has leased another factory at 50 Cortlandt street, and will be ready to resume delivery of goods some time this week or early next.

THE STANLEY ELECTRIC COMPANY.

The new Stanley electric company was organized at a meeting held Saturday evening, says the Pittsfield, Mass , *Eagle*, of Dec. 4, when these officers were elected: President and treasurer, Charles Atwater; clerk, George H. Tucker; directors, William Stanley, Jr., W. A. Whittlesey, Charles Atwater, George H. Tucker, Henry C. Clark, Charles E. Hibbard and W. W. Gamwell. Another meeting was held last evening when the affairs of the company were discussed, and plans for getting under way were considered. It has not been definitely settled where the new company will locate, but the probabilities are that a portion of the new Morton block on McKay street will be leased. This building is very substantially built and is in every way suitable for the purposes desired. The new company will probably get started in about six weeks and will first begin the manufacture of converters. Several skilled machinists and a number of helpers will be employed at first, and the number will be increased as the extension of the business warrants. Much heavy machinery will be used. Later on the company will engage in the manufacture of different kinds of electrical apparatus, and bids fair to become in time, a very considerable institution. The company was projected by Mr. Whittlesey who, by the way, is a wide awake and energetic as well as most courteous business man. The choice of officers has been most fortunate as they are all practical and capable business men. The new company is also to be congratulated on having Mr. Stanley so directly interested in it, as his knowledge of the electric business coupled with his remarkable inventive genius, makes him a most valuable man for such a concern. The new electric company starts off under the most favorable auspices and its future is certainly very bright. It is a grand accession to the business interests of Pittsfield, and the new city is to be congratulated on being selected as the home of such a promising concern.

NEW ENGLAND TRADE NOTES.

THE GOULD AND WATSON COMPANY, BOSTON.—On page 561, of our issue of November 19th we illustrated the new Cushing switchboard for electric lighting in theatres, and we desire to call more particular notice to the moulded mica insulating material of which the insulating parts of this board were made. Messrs. J. P. Cushing & Co., who manufactured the board, gave a great deal of attention and preliminary experiments to the selection of this material, and it was found that moulded mica was the most suitable of any material experimented with, it being extremely hard and strong, perfectly waterproof and fireproof. Undoubtedly this material is coming rapidly to the front as a reliable and durable insulator, and its merits ought to be thoroughly investigated by all manufacturers of electrical apparatus.

THE GETHINS ELECTRICAL MANUFACTURING CO., of Boston, have added a new department to their enterprise. Special provision has been made for the charging of storage batteries at their offices at 620 Atlantic avenue, for which their cell is particularly adapted. Anyone using storage batteries can now readily and promptly have their batteries charged by making arrangements with the Gethins Company, a privilege which will be readily appreciated by many.

WESTERN TRADE NOTES.

MR. SPRUANCE, of the Star Electrix Company, of Philadelphia, was a welcome visitor to Chicago last week.

MR. GEORGE CUTTER, whose name is so well and widely known in connection with various and important lines of electric development, is again in business for himself as a dealer in electric specialties. From his handsome new quarters in The Rookery he intends to push the most improved appliances for electric light and power plants. He controls a number of such devices, which are very highly thought of, and many of which are the product of his own fertile inventive talent, and, besides, he is arranging to handle numerous others of equal merit. In addition to this portion of the industry, his long and varied experience in all kinds of electrical work would seem to fit him peculiarly for acting as consulting electrician, to which work he will devote a portion of his time. As has always been his custom, he will be surrounded by a picked corps of assistants, and this, together with the success with which he has previously met, bespeaks for him a most prosperous career. Mr. Cutter in his new field will undoubtedly receive the efficient support of his many friends, who hold him in the highest esteem.

THE ELECTRICIANS' TIME CO., 167 Dearborn street, Chicago, who deal so largely in watches, diamonds, jewelry, etc., will issue a new and complete catalogue, profusely illustrated, January 1st, 1891. They make a specialty of catering to the electrical trade, and are doing a large and thriving business. The Giles non-magnetic shield which they furnish is a complete preventive of magnetism affecting watches, and is in large demand. Early application should be made for a copy of the new catalogue, as many new and interesting specialties will be found therein.

MR. C. B. HANNA, the popular general agent of the Carpenter-Nevens Electro Heating Company, is at the Wellington Hotel, Chicago. He is making arrangements for a large and most complete factory here for the manufacture of their electric heating apparatus. Their system of electric car heating, fully illustrated and described in the last issue of THE ELECTRICAL ENGINEER, is meeting with widespread approval, and every street railway man should investigate its numerous and marked advantages and merits.

THE GREAT WESTERN ELECTRIC SUPPLY CO., 190–192 5th Av., Chicago, are now busily engaged in preparing a new and complete catalogue of their various electric light, power and street railway supplies and specialties, which they expect to issue about the first of the year. This action has been rendered an imperative necessity, owing to the enormous demand for their sketch catalogue, which they recently brought out. The catalogue of supplies and house goods will occupy a whole book, and the fixture catalogue another; and both will compare very favorably with anything of the kind ever brought out.

THE
Electrical Engineer.

VOL. X. DECEMBER 17, 1890. No. 137.

THE RIKER LOW SPEED MULTIPOLAR MOTORS AND DYNAMOS FOR CONTINUOUS CURRENTS.

BY A. L. RIKER.

THE subject upon which I desire to advance a few ideas, has received considerable attention lately from electrical engineers. The point which I desire to emphasize is the advantages to be gained by low speed motors over high speed motors or dynamos.

In a dynamo plant any saving of space is a very important item. Most high speed dynamos are belted to the engine, all of which occupies space. With the low speed dynamo the shaft of the generator and the shaft of the engine (which latter can in this case also be of low speed) are coupled directly together; thus not only saving by direct connection, but power and wear and tear on plant by effecting a decrease in friction. The reduction in friction is about nine times, meaning a proportionate reduction in wear and vibration. There is no counter shaft required, nor is there loss by slippage of belt or driving cones.

The low speed motor has similar advantages and its consequent noiseless running makes its employment possible, where the use of a high speed motor could not be considered. To all users of machinery the economic advantages of low speed machines will be at once apparent.

As multipolar machines and their operations are very well known, I will not go into the subject generally, but will confine my remarks to a multipolar machine of my own

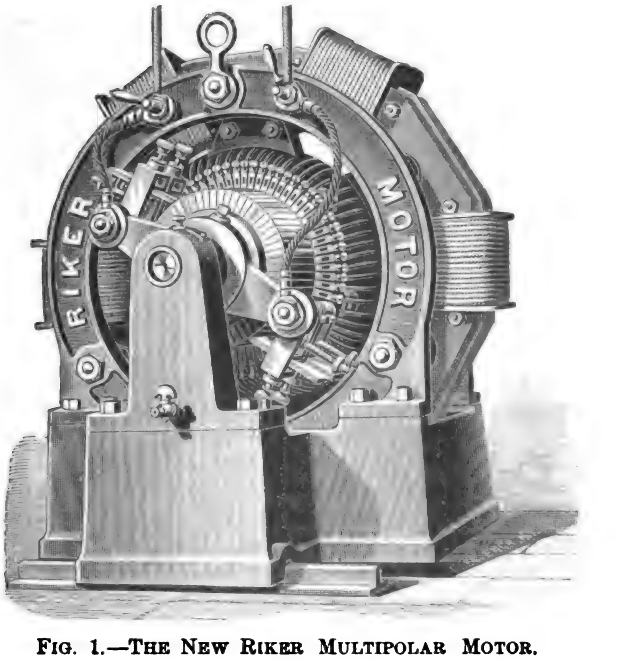


FIG. 1.—THE NEW RIKER MULTIPOLAR MOTOR.

design, which embodies several novel and important improvements.

In a multipolar machine it is necessary to have as uniform a field as possible, and as the consequent pole type of magnet on closed magnetic circuit is most uniform, I have adopted it. The accompanying engraving, Fig. 1, is a view of my 5-h. p. motor; Fig. 2 is a diagram of the magnetic circuit of the machine under consideration. As will be seen by reference to the diagram, the magnetic circuit is very short, completely surrounding the armature and concentrating the lines of force, so that very little copper is used and a high efficiency is attained.

The path of the lines of force forms almost a circle. The

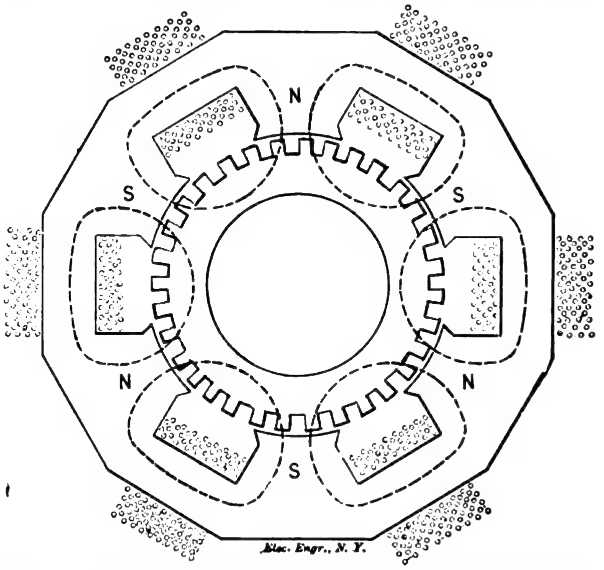


FIG. 2.—MAGNETIC CIRCUIT, RIKER MULTIPOLAR MOTOR.

field is produced by six magnetizing coils producing six consequent poles. The entire field is composed of plates of soft sheet iron, built upon six bolts of non-magnetic material, which pass through the pole pieces, three of which are continued through and bolted to the supporting rings on either side of the machine.

As in all machines of my design, the armature is a toothed ring, supported by six bolts passing through and insulated from the armature core and mounted on two spiders of non-magnetic material, and which, in turn, are keyed to the shaft. The winding is the ordinary Gramme winding.

In a six-pole machine it is necessary to use either six brushes or to cross connect the commutator. The first method is preferable where carbon brushes are used, but where copper brushes are employed cross connecting is better. As the placing of six brushes around the commutator is well understood, I will describe my method of cross-connecting by which two brushes placed diametrically opposite are used as in a two-pole machine. These cross-connectors are placed inside the commutator, and their construction will be understood by referring to Fig. 3, which is an end view of one of them.

A sectional and longitudinal view of the commutator are given in Figs. 4 and 5. Here A represents the commutator sleeve, which is insulated from the cross-connector C by the air space B. Each cross-connecting ring is stamped out of sheet copper and is let into and soldered to three bars placed respectively 120, 240, 360 degrees apart in the commutator, as shown in Fig. 5.

These rings are thoroughly insulated from each other and are entirely enclosed within the commutator, prevent-

ing any danger of short-circuiting and making the commutator as compact as that of a two-pole machine.

Another feature of this machine, which is among the first in importance and one that is often overlooked, is the method of lubricating. A very simple and efficient oiler

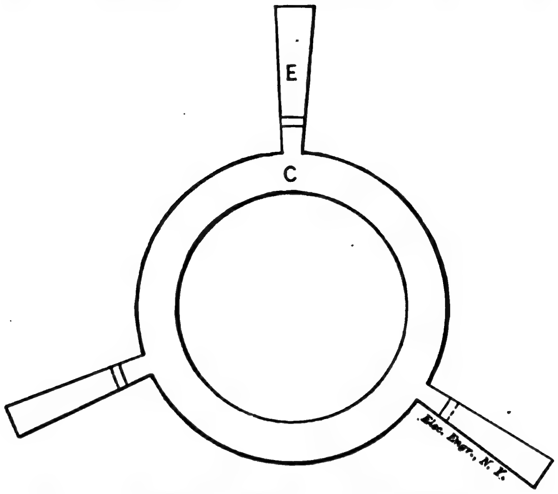


FIG. 3.—CROSS CONNECTOR FOR COMMUTATOR.

has been applied to them. The bearings are cast hollow and the bushings, through which the armature shaft runs, are slotted, exposing the shaft, over which, and dipping into the oil well below, runs a chain acting on the principle of the chain pump; this thoroughly oils the shaft and is entirely automatic in its action.

The bearings are so constructed that they cannot (as it is familiarly expressed) "sling oil." They require no attention further than to be filled once a month and the waste oil drawn off.

These machines are built from 5 h. p. upward. A special adaptation of this multipolar type is constructed for railway work to run at 400 revolutions per minute and is geared direct. This machine weighs about 60 pounds to the horse-power.

Aside from the question of speed, a number of minor

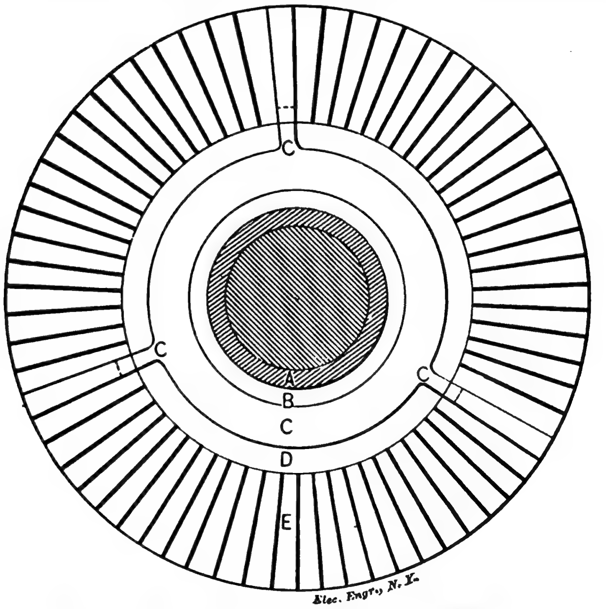


FIG. 4.—COMMUTATOR AND CROSS CONNECTOR.

points, which go far toward making a perfect machine, have received considerable study. Among others, attention is called to the brush holder and also to the binding posts to receive the wires from the mains.

The following are the data relating to the construction of my 5, 10 and 20 horse-power machines: 5 h. p. motor; Speed, 550 revolutions per minute; weight, 450 pounds; armature resistance, .166 ohm; shunt field, 100 ohms.

10 h. p. motor: Speed 550 revolutions per minute; weight 800 pounds; armature resistance .08 ohm; shunt resistance 75 ohms.

20 h. p. motor: Speed 550 revolutions per minute;

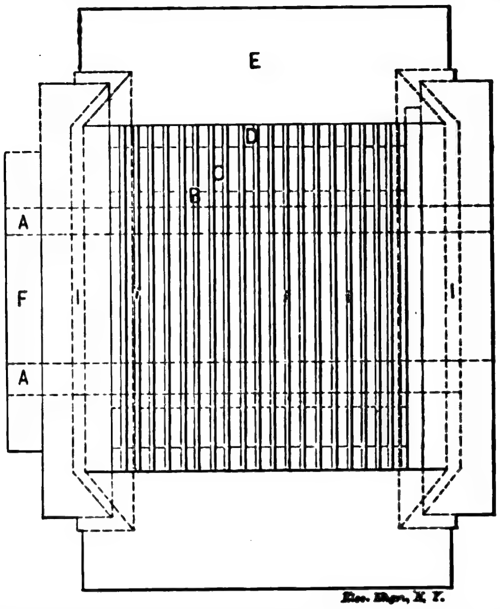


FIG. 5.—COMMUTATOR OF RIKER MOTOR, SECTION.

weight 1,150 pounds; armature resistance .037 ohm; shunt resistance 27 ohms.

ELECTRIC MOTORS TO TUNNEL IN THE ARGENTINE REPUBLIC.

The new railway which is to connect the Argentine Republic with Chili will necessitate the boring of eight tunnels through the Andes mountains of a total length of 15,875 m., or nearly 10 miles. These tunnels, in whose construction water power and electricity are to be largely employed in a novel form, have already, says *Engineering*, been commenced at 20 points. Since August last a cataract of the Juncalillo river, which has a fall of nearly 600 ft., has been made use of to supply the power in carrying out the boring operations in the tunnels of Portillo, La Calavera and La Cumbre. The Portillo tunnel takes a serpentine course through the massive rock, and its upper end emerges at the mountain side, 450 ft. above the entrance. The water of the Juncalillo cataract is conveyed through steel pipes half a meter in diameter for the distance of about a mile to the Juncal station. The boring machines employed in these three tunnels require a force of 1,000 horse-power to drive, and this is obtained by converting the water power into electricity. The water which is carried through the steel pipes is made to set in motion 10 turbines, each of 80 horse-power, which are connected with the electrical machines. The electricity thus produced is conducted through strong, insulated copper cables to Juncalillo and Calavera. From Juncalillo air-pressure machines are also supplied in the serpentine tunnel leading up to Portillo. From Calavera four 80 horse-power dynamo machines generate the electricity for the Cumbre tunnel, where six borers, all working at the same time, are driven by eight air-pressure engines. On the Argentine side of the mountains another cataract, near Navarro, has been similarly used for driving four turbines, each of 80 horse-power. Owing to the distance of the western smaller portion of the Cumbre tunnel, water power cannot there be employed, and the borings are being carried out by hand. Wherever water and electricity can be used, the boring operations are performed, it is estimated, fully four times as rapidly as they would be by hand. The cost and progress of the borings accomplished by this novel application of water power and electricity cannot at present be estimated, but the figures, which will be made known on the completion of the undertaking, can scarcely fail to prove of considerable interest to the engineering profession.

A CHARGE INDICATOR FOR ACCUMULATORS.

At a recent meeting of the Société Internationale des Electriciens, M. Gaston Roux described a form of direct reading charge indicator devised by him for use with accumulators. The apparatus is based on the fact that within certain limits the density of the electrolyte varies according to the quantity of electricity stored in a storage cell in a chemical form. Experiments carried out by M. Roux show that the temperature correction is entirely negligible between 0°C and 30°C. M. Roux employs a long cylinder reaching nearly to the bottom of the cell in order to take into account the want of homogeneity of the liquid. This cylinder is hung from the end of the short arm of a small lever, which should be horizontal when the cell is fully charged. On the same axis as the lever, and on the same side as the cylinder, there is arranged, at an angle of 45 degrees with the lever a small rod, along which a small weight can be screwed. On the long arm of the lever there is also an adjustable weight. At right angles to the lever there is a long pointer moving over an equally-divided scale. When the cell is discharged to its working zero, the pointer is brought to the scale zero by adjusting the weight on the long arm of the lever. When the cell is fully charged the pointer is brought to 100 by adjusting the weight on the rod fixed at 45 degrees with the lever. The instrument being thus adjusted for a particular cell the percentage state of charge of that cell at any moment is seen from the position on the scale occupied by the pointer. An instrument such as this should prove of considerable use in an isolated installation, where a storage battery is left in the hands of an unskilled attendant.

THE ELECTRIC METER COMPETITION IN PARIS.

The Municipal Council at Paris in conformity with the recommendations presented by M. Sauton has named the following gentlemen as part of the jury to examine and report upon the electric meters submitted for competitive test: MM. Mascart, Potier, Hospitalier, Cochin, and Lyon-Alemand. The members to be nominated by the administration of works have not yet been designated. Among the American meters submitted for test are the Thomson, the Walker and the Grove.

THE CLAUS-EASTON INCANDESCENT DYNAMO.

There was a time when dynamo construction was very largely a matter involving experiment in order to determine the best proportions and methods of construction, but the progress which has been made is such that the results to be obtained from any one design may be predicated with an accuracy which is second to that afforded by no other prime mover or generator of energy. It is also worthy of note that besides the increased accuracy and simplicity of electrical construction, the mechanical design of machines has been not less the subject of study and improvement. A machine in which both these essential elements have been well brought out is that illustrated in the accompanying engravings and which is known as the Claus-Easton dynamo. It is now being constructed by the Easton Electric Co., of this city, whose arc lighting apparatus is already well known.

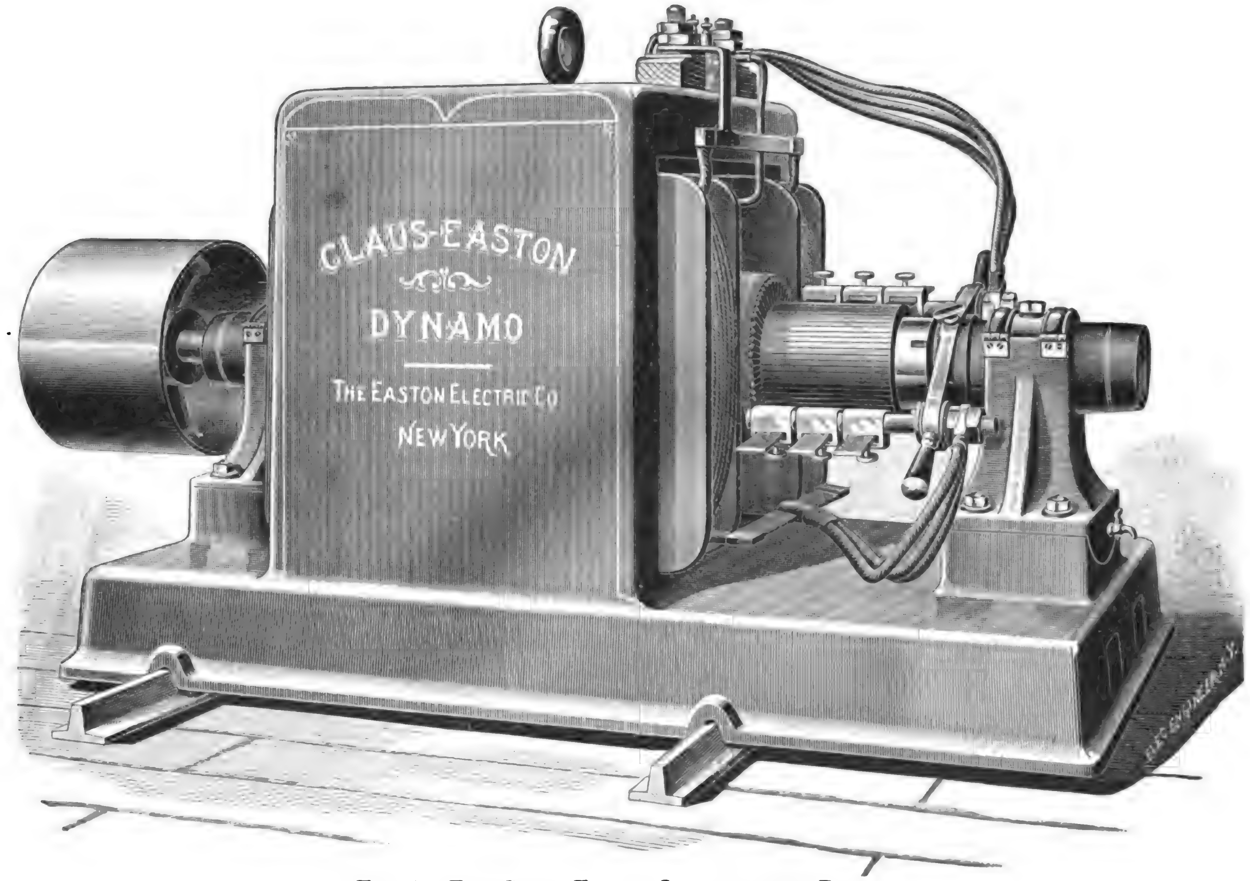


Fig. 1.—The Claus-Easton Incandescent Dynamo.

The simplicity of construction of the Claus-Easton machine will be well understood from the illustrations, Figs. 2 and 3, which show the same in section and in elevation. The entire magnetic frame of the machine, including the base, consists of but a single casting, which requires merely the boring out of the armature space between the pole pieces and the bearings for the shaft to complete it for the reception of the armature. The magnet coils are wound on bobbins in a lathe and slipped over the magnet cores. The mechanical construction is, therefore, of the most simple character imaginable, so that any repairs which may become necessary can be effected in the most simple manner in the least time.

The electrical details of the machine have also been worked out very carefully. The machine illustrated in Fig. 1 is intended for 800 half-ampere 16 c. p. lamps, and is, therefore, designed to give a current of 400 amperes. The armature is of the Siemens type, built up of laminated

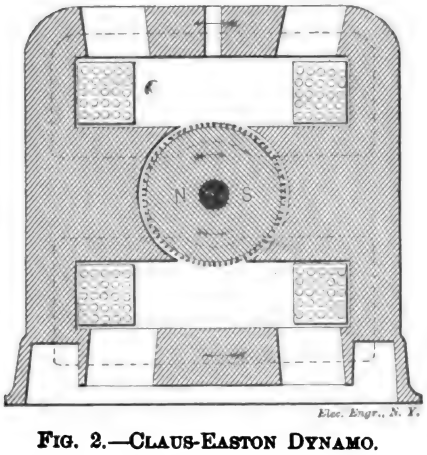


FIG. 2.—CLAUS-EASTON DYNAMO.

sheet iron and has a resistance of 0.0096 ohm. The machine in order to maintain constant difference of potential at all loads is compound wound, the shunt having a resistance of 9.177 ohms, and the series coil a resistance of .0164 ohm. With the winding adopted, the regulation is so close that no perceptible variation of po-

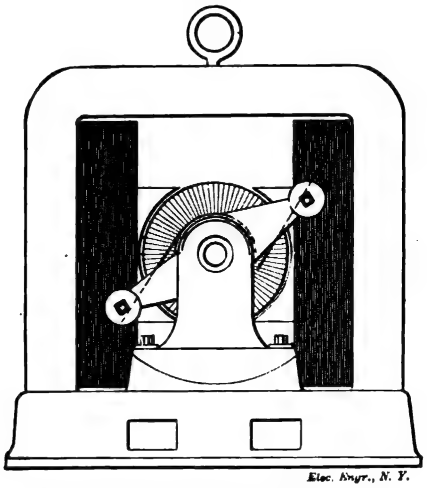


FIG. 3.—CLAUS-EASTON DYNAMO.

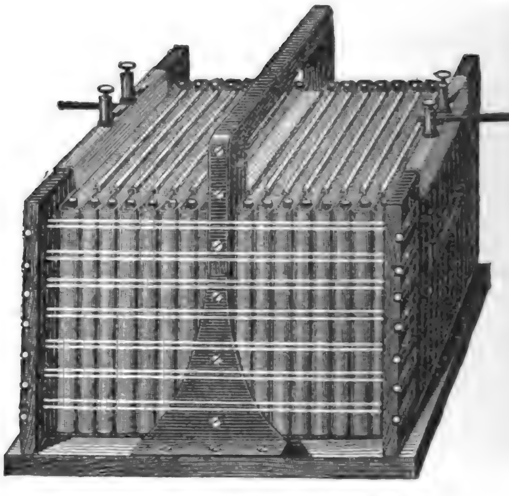
tential occurs between full load and practically no load. These machines are now being built in various sizes and those in use have given general satisfaction.

REYNIER'S HIGH VOLTAGE ELASTIC ACCUMULATORS.[1]

FOR some time past M. Emile Reynier has been at work perfecting a battery designed to afford in a single compact structure a high voltage and at the same time have the necessary qualities of solidity and portability. As a result, the battery has taken the shape illustrated in the accompanying engraving. It consists of 16 plates mounted in flexible pockets, so as to have a certain amount of elasticity. These elements are placed flat, one against the other, and compressed between two end plates of wood by means of rubber spring bands. A bridge, consisting of hard wood impregnated with a waterproofing material, carries the whole, which may be suspended or rest upon its base, as desired.

The spring arrangement gives to the active solid matter an artificial elasticity, which results in large specific power and storing capacity. The continuous compression of the plates, insulators and flexible pockets insures for these thorough protection against shaking and rough handling. Each of the pockets into which the plates are inserted is closed on top by means of a flexible and insulating stopper.

We give below the principal figures relative to the cell,



REYNIER'S ELASTIC HIGH POTENTIAL ACCUMULATOR.

which has 16 couples and which is known as the horse-power-hour type.

E. M. F.	32 volts.
Available fall of potential	28 volts.
Current discharge	3 to 6 amperes.
Normal power, about	150 watts.
Capacity	30 ampere hours.
Available useful energy	740 watt hours.
External dimensions: Length	0.40 metre.
External dimensions: Breadth	0.30 "
External dimensions: Height	0.30 "
Contents, without containing cell	36 cub. decim.
Total weight without cell	50 kilogr.
Weight per kilowatt	330 "
" " kilowatt-hour	67 "
Volume " "	240 cub. decimetres.
" " " "	49 " "

Without mentioning the applications to the military art, there are many instances in which a horse-power-hour cell such as this would be of service, as, for instance, in the lighting of carriages, railway cars, and the propulsion of electrical pleasure boats, etc.

LIMITATION OF STREET RAILWAY FRANCHISES.

The city of Toronto, Can., has lately taken steps, under terms of a lapsing franchise, to acquire the local street railway property. The company has asked $5,500,000, but the city expects to pay only about $1,500,000. Last year the road earned net $250,000. Discussing the situation, the Chicago *News* says: "The streets of every city are the property of the citizens, and no corporation has a right to use them as private property. This usurped right is especially flagrant when the growth of population, as in Chicago, converts street railway monopolies into gold mines. Still more flagrant is the case of these monopolies arrogating such proprietary rights as to make war with the citizens on the questions of accommodations, reasonable fares, etc.

"Chicago needs to learn a lesson from other and less pretentious cities in the limitation of public franchises. Every ordinance giving street car corporations the right of extension should contain a clause limiting the life of a franchise to a reasonable term of years with the privilege of purchase by the city on its expiration at an arbitrated valuation. To those who may object to direct municipal control of street railways it need only be said that such direct control is not contemplated. The method prevailing in many English cities is for the municipality to retain the ownership of the tracks and real estate, leasing the rolling stock to the company that pays most for the privilege of operating the road. This is the method which will probably be followed in Toronto. It solves every objection, as the increment from the property goes into the city treasury instead of into the coffers of the corporation."

1. *L'Electricien.*

A PRACTICAL GUIDE TO THE TESTING OF INSULATED WIRES AND CABLES.—V.

BY HERBERT LAWS WEBB.

KEYS.

A form of *short circuit* key is shown in Fig. 18. As its name implies, the function of this key is to short circuit the galvanometer; being bridged across the galvanometer circuit, when the key is closed, a direct path for the cur-

FIG. 18.—SHORT CIRCUIT KEY.

rent is provided by the lever of the key and no current passes through the galvanometer; when the key is opened the galvanometer is thrown in circuit and the current passes through it. By the use of this key the galvanometer is protected from being violently deflected by the first rush of charge when current is turned on, and when a balance is being obtained in a resistance test with the dial bridge.

The form of key shown consists of a brass lever, hinged at one end, and playing in a brass bridge, having a metallic contact above and a stop of insulating material below. On the hard rubber pillar which supports the lever, and on the bridge, are placed double binding-posts to which the wires are attached. In its normal position the lever is pressed by a stiff spring against the upper contact, and forms a direct connection between the binding posts; by pressing it down the contact is broken, thereby removing the short circuit. A trigger attachment, mounted opposite the end of the lever, holds the key in the open position as long as may be desired.

A better form of this key than the one shown, is that in which, instead of the pivoted lever, a strip of springy brass is used, being held rigidly at the end fixed to the hard rubber pillar. With this kind of key there is no risk of imperfect contact through weakening of the spring, a very annoying defect to which the other is liable.

Besides these keys, which are indispensable, a very useful instrument on the testing table is a galvanometer reverser. It is often convenient to have all the deflections on the same side of the scale, and to effect this, when the battery is reversed, it is necessary to change the direction in which the current enters the galvanometer. To do this, any form of battery reversing key, such as those shown in Figs. 14 and 15, may be employed, but preference should be given to the double-plug switch shown in Fig. 19.

This consists of a circular plate of brass, divided into four quadrants, which are mounted on hard rubber pillars, rising from a base of the same material. Each quadrant is provided with a double binding-post for attaching wires, and two brass plugs, with insulating handles, serve for connecting the quadrants in pairs. This switch is connected in the galvanometer circuit, and the direction in which the current enters the galvanometer may be changed by simply altering the plugs. The plugs should have long stems, so that the hard rubber handles or tips may project clear above the binding-posts, giving greater convenience in handling than the short plugs used for resistance boxes and bridges.

RESISTANCE BOXES.

IN a complete outfit of testing instruments a high resistance for taking the constant of the galvanometer and a Wheatstone bridge for measuring resistances are absolutely necessary, and a box containing a number of coils having different resistances is a very useful addition.

The high resistance box generally contains four coils of 10,000, 20,000, 30,000 and 40,000 ohms resistance, making 100,000 ohms resistance in all. This instrument is illustrated in Fig. 20. The ends of the coils are brought to brass blocks on the top of the box, these blocks being provided with double binding posts and connecting plugs, so that the coils may be connected in any combination desired, although the most general manner of using the coils is all in series, giving the full resistance of 100,000 ohms.

High resistances are also made up containing ten coils of 100,000 ohms each, giving a total of one megohm. A megohm resistance enables the galvanometer constant to be taken with greater accuracy and allows of the galvanometer being adjusted to its maximum sensitiveness; but such a high resistance is very expensive, costing about seven times as much as a 100,000 ohm box. A firm of electrical instrument makers in England have lately brought out a high resistance box, containing a mixture of glass and metal, instead of wire; these instruments have to be calibrated after they are made, as it is impossible to give the mixture any fixed resistance. They generally have a resistance of several megohms, but rarely come out in round numbers, running, instead, to at least two decimal places. This is somewhat inconvenient in multiplying, but as an offset the instruments are very cheap, the price being about one-half that of a 100,000 ohm box. Given this advantage, and if the resistance remains reasonably constant with time and temperature, this form of high resistance box will no doubt find many users. I understand that it has already been adopted by several of the submarine cable companies.

The *Wheatstone bridge* is made up in a variety of forms,

FIG. 19.—DOUBLE PLUG REVERSER.

of which the most convenient are those known as the dial and the Post-office patterns. Both these styles have their advantages, the former being very easy to read and involving the handling of few plugs, while the latter is more compact and easier to manipulate, as the battery and galvanometer keys are permanently connected to the coils and form part of the instrument. Dial bridges are now being manufactured, however, with this convenience, the keys being placed in front of the dials similarly to the arrangement of the Post-office bridge.

The function of the Wheatstone bridge in the measure-

ment of resistances has already been explained and will be further treated of when we come to actual testing instructions, so that it will be sufficient here to describe the connections and plan of the instruments themselves. The dial form is illustrated in Fig. 21. The coils are arranged in sets of thousands, hundreds, tens and units; sometimes a fifth set of tenths of an ohm being added. The ends of the coils are brought to the brass segment blocks arranged around a circular plate of brass.

Starting from one end of the proportional coils connection is made to the zero segment of the end set of blocks; the resistance coils are placed between the segment blocks, one between 0 and 1, one betweeen 1 and 2, and so on, and the circular plate of each dial is connected to the zero segment block of the next, and so on throughout. Thus the number of the segment block connected by the plug to the circular plate represents the number of resistance coils in circuit, whether they be units, tens, hundreds, or thousands. The proportional coils terminate in brass blocks placed at one side of the adjustable resistance coils. These proportional coils form the two arms of the bridge or balance, and by altering their relation to each other the adjustable coils may be adapted to measure either very high, or very low, resistances. In the dial bridge the two sets of proportional coils usually consist of 10, 100, 1,000 and 10,000 ohms resistance. The battery current splits at the centre of the proportional coils, one part going through one set to the adjustable resistance coils, the other part going through the opposite set to the unknown resistance to be measured.

If the resistance unplugged in the proportional coils is the same on both sides, the readings obtained by the adjustable coils will be the actual value of the resistance which is being measured. If the resistance to be measured is very small we can obtain its resistance to three decimal places by unplugging the 10,000 ohm coil in the arm nearest the adjustable coils and the 10 ohm coil in the arm

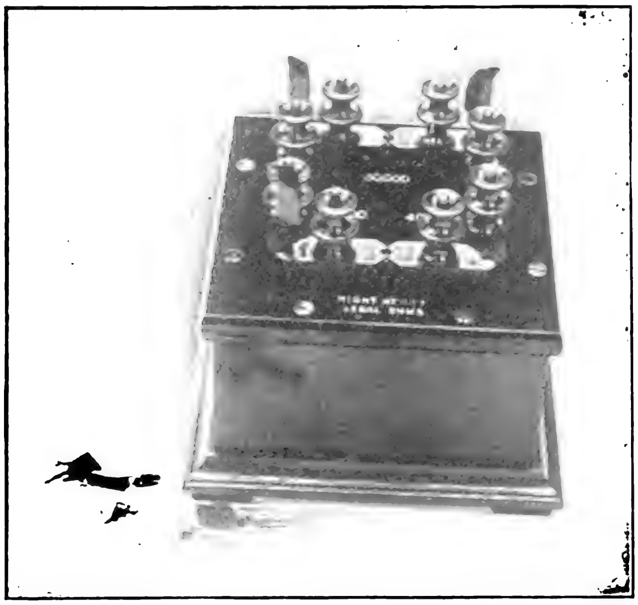


Fig. 20.—High Resistance Box.

to which the unknown resistance is connected. Then, as b (the resistance between battery and coils) is 1,000 times greater than a (the resistance between battery and unknown resistance), so d (the resistance in coils) is 1,000 times greater than x (the unknown resistance), and the reading obtained must be divided by 1,000 to find the true value of x.

In the same way, if the resistance of x is known to be much greater than the maximum value we can give to d while a and b are equal, then, by making a greater than b, the reverse is the case, and the readings must be multiplied by the ratio of a to b in order to find the value of x. With proportional coils of 10, 100, 1,000 and 10,000 ohms, therefore, the bridge has a very wide range, being capable of measuring from .001 of an ohm to 10 megohms. It must be borne in mind that some resistance must always be

Fig. 21.—Wheatstone "Dial" Bridge.

unplugged in the proportional coils, as otherwise the galvanometer, which is connected to their extremes, would be short-circuited.

OVERHEAD ELECTRIC LIGHT CONDUCTORS.[1]

The following illustrations, Figs. 1 and 2, represent three varieties of aerial conductors. No. 1 is that required by

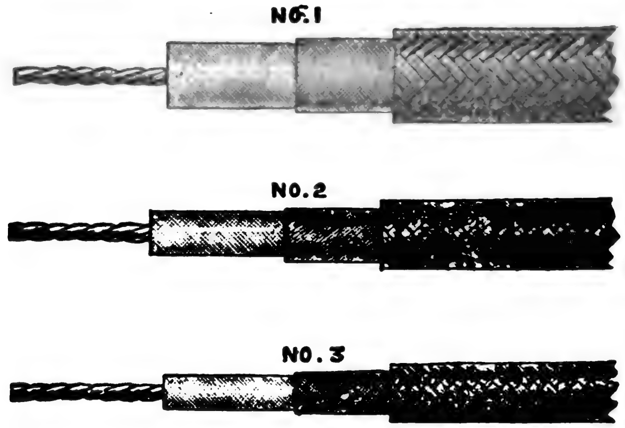


Fig. 1.—English Overhead Electric Light Conductors.

the Board of Trade. No. 2 is a compromise which has been suggested by Mr. Crompton. No. 3 is an ordinary conductor such as has been in vogue up to the present for the class of work for which the Board of Trade now demands No. 1.

No. 1. $\frac{7}{16}$ cable. Insulated according to Board of Trade regu-

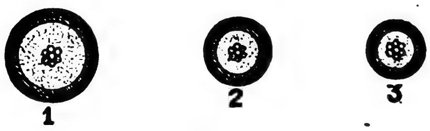


Fig. 2.

lations. Thickness of rubber, .121″. Diameter over serving, .489″.

No. 2. $\frac{7}{16}$ cable. Medium insulation. Thickness of rubber, .07″. Diameter over serving, .355″.

No. 3. $\frac{7}{16}$ cable. L quality. Thickness of rubber, .042″. Diameter over serving, .306.

1. *The Electrician.*

ELECTRICAL ENGINEERS.

RUDOLF EICKEMEYER.

Those who are in the slightest degree familiar with the course of electrical invention and improvement must have been impressed with the frequent occurrence and repetition of the name of Eickemeyer, and the impression gathered has doubtless been that, whoever Mr. Eickemeyer might be, he certainly was devoting himself to electricity in a very enthusiastic, thoroughgoing and successful manner. In point of fact the reputation that Mr. Eickemeyer has gained in electrical circles comes to him somewhat late in life, and is really but a pendant to that which has long been his in other fields of work. As proof of this, and putting aside other achievements to which reference will be made later, it may be stated that for 40 years he has been the most prolific inventor of hat making machinery and processes in America, his name being known to the hat industry all over the world.

R. Eickemeyer

Rudolf Eickemeyer was born October 18, 1831, in Bavaria, where his father was a forester. At the age of thirteen he left the village school, and attended the Real-Schule at Kaiserslautern, whence he removed in two or three years to the Polytechnic Institute at Darmstadt, where he devoted himself with much energy to the scientific and technical studies of the place. He made rapid progress, his tastes all lying in that direction, but it was destined that he should not gratify in peace his thirst for knowledge. The revolutionary fires of 1848 were breaking out with volcanic suddenness all over Europe, and from one end of the Continent to the other people rose in insurrection. This democratic movement was most intense and active in the smaller kingdoms and principalities where the few remnants of feudalism and medievalism became more irksome than the whole régime had once been; and the struggle for liberty of thought and action naturally enlisted at once a youth of so ardent a temperament. Still a mere boy, Rudolf, with his classmate George Osterheld—who afterwards became his business partner here—threw himself heartily into the fray, joined the "rebels," and fought under General Siegel. But the time was not ripe for revolt, the movement failed, and the suppression of the rebellion placed the participants in it in a very unenviable position. It is true that Eickemeyer and Osterheld were amnestied, but their future was darkened. Like others who took part in the risings in Germany at that time, they soon left home for America; and the two young men landed in New York, in November, 1850.

The Erie railroad was being built at that time, and Mr. Eickemeyer found employment on it at Lodi. The year after, 1851, he secured a position at Buffalo, in the Buffalo Steam Engine Works, his duty being to assist in making the first mowing machines produced in this State. In 1854, he established himself at Yonkers, in association with Mr. Osterheld, in the business of repairing the tools used in the hat shops and other factories of that busy little city on the Hudson. The work at first was wearisome and ill paid, but a footing was soon gained, and a start was made for which Mr. Eickemeyer has since repaid Yonkers many times over.

It was now that his inventive genius first began to display itself effectively. He had long been a master of the principles of mechanism, but he had never before been thrown into close contact with a growing industry hampered by the crudity of its productive apparatus. He now had the direct appeal made to the practical side of his imagination, and in a very short time he began the course of invention which has since practically re-created the art of hat making as practiced in America and abroad. It would be foreign to our purpose to speak of his improvements in this industry in detail, but we may say that they include every detail and are embodied in hat blocking machines, hat shaving machines, stretchers, blockers, formers, presses, ironing machines, sizing machines, sewing machines, fulling mills, machines to pounce hats in a cone shape, and a variety of others, automatic in operation, and exhibiting the greatest ingenuity in substituting the operation of mechanism for slow, laborious and costly methods of hand production. The factory for the manufacture of such machinery was built at Yonkers, in 1865, and has since that time been kept in active operation with a large force of skilled machinists.

At the beginning of the civil war, Mr. Eickemeyer was quick to see the opportunity of using his hat sewing machine tools in the manufacture of firearms, and thereafter for a number of years large quantities of revolvers were made at Yonkers, as a distinct department of the busines. In 1869 and 1870, Mr. Eickemeyer invented and perfected a driving mechanism for mowing machines, which proved to be extraordinarily simple and smooth running, and which, when exhibited at the Centennial Exposition, was awarded a bronze medal for its lightness of draft. It should be added that three other bronze medals were awarded Osterheld and Eickemeyer at the same time for their exhibit of hatting and other machinery. The mowing machine referred to has since been manufactured on an extensive scale at Springfield, O., and in a modified form as a one-horse mower, by a firm in Yonkers.

The above recapitulation of Mr. Eickemeyer's work, is, as will be seen, the merest outline, but it will suffice to justify the remark made at the beginning of this biographical sketch to the effect that his electrical work has been but a corollary to his remarkable inventions in other branches, represented by not less than 150 patents, some of which are of great value. If our readers desire to see what is thought in the hat trade of his work, we may refer them to a most interesting and instructive article published by the New York *Hat, Cap and Fur Trade Review*, in August, 1882.

Mr. Eickemeyer had always followed in a general way

the various advances in the sciences, taking great interest in electricity, and when the Bell telephone was brought out, having more time and means at his disposal than he had previously enjoyed, he took up electricity as a study for his leisure rather than with a view to apply it in a practical way. Experimenting with various forms of telephones, he became familiar with the peculiarities of different forms of electro magnets, and from their use in telephones to the construction of dynamos was but a step. The celebrated ironclad dynamos and motors known as the "Eickemeyer" were the first attempt on his part to put to practical use the results of electrical studies and investigations extending over a space of nearly ten years. They have proved very satisfactory, and their operation under a variety of conditions during the last three years has shown them to be electrically and mechanically the equal of the best known machines in the market. Dynamos of this type have been built, varying in output from 2,500 volts and 10 amperes to 5 volts and 500 amperes, and the results have been gratifying in all cases, but perhaps most so in train lighting, where the solidity of the machine has been of great service. Although some 25 machines have been employed in this trying work, not a single armature has been burned out or in any way injured.

The Eickemeyer motor has also been applied to electric railway work, and found highly efficient. The construction of a slow running motor, coupled directly to the driving shaft of a street car, seems to open up a new field and mark a new departure in electric traction, as it avoids the use of gearing, which is still the weak point and bugbear in street railway work. It deserves mention here that the Edison system has adopted the Eickemeyer winding for its railway motors.

The question of the best material to be used in the construction of dynamos caused him to set to work to get some instrument which would enable him to determine readily the relative values, magnetically, of various qualities of iron and steel; and the result was a magnetic bridge, by means of which the magnetic value of the material can be told as readily as a loaf of bread is weighed on the scales of a bakery. The instrument has proved a complete magnetic laboratory in itself, and by its use Mr. Eickemeyer has been able to determine many questions in the construction of electric devices, which, without it, would have been difficult and expensive experiments.

Mr. Eickemeyer has also done some very interesting work in connection with the storage battery and the alternating motor, and in the latter respect his work is surprisingly early, anticipating it would seem, by years, many of the machines lately put forward as startling novelties. He is as active, too, in electrical work to-day as he has ever been, and far more than the Patent Office files would indicate, it being his invariable practice to build and run every new machine before patenting it or the principles it embodies.

Mr. Eickemeyer was married in 1856 to Miss Mary T. Tarbell, of Dover, Me., and the eldest of his six children, Rudolf Eickemeyer, Jr., is now a member of the firm. Mr. Eickemeyer, has, unlike the majority of well-known inventors, found time for the performance of various public duties, and has rendered conspicuous service on the Yonkers School Board and Board of Water Commissioners. Our portrait of him, recently taken, is very faithful and characteristic.

SEPARATING COPPER FROM ARSENIC.

If the current of four or five cells is passed through an arseniate solution, rendered alkaline by means of ammoniac, no separation or reduction of the arsenic acid takes place; but if a solution of copper salts is so treated, there is a complete separation of the copper. This difference of action has, according to *Electrotechnische Zeitschrift*, been utilized to separate arsenic from copper. The experiments were made with solutions prepared beforehand, and after 24 hours it could be ascertained by weighing that all the copper was deposited.

THE ELMORE PROCESS OF MAKING METAL TUBES BY ELECTRO-DEPOSITION.

The process of producing metal tubes by electro-deposition as practiced in the Elmore process has recently been patented in this country by Mr. Francis Edward Elmore, of Cockermouth, England. As the process is just now attracting considerable attention abroad, and may be shortly introduced in this country, we give in the accompanying

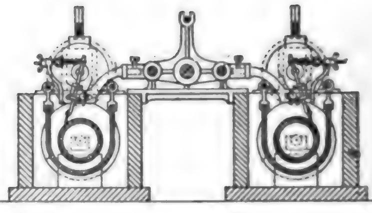


Fig. 1.—The Elmore Copper Depositing Process.

engravings, Figs. 1 and 2, an idea of the plan adopted for obtaining the metal tubes of tough copper.

The latter quality is obtained by burnishing the surface of the deposited tube or other article during the time at which the deposit is going on in the tank. The core or mandrel to receive the deposit is mounted in the tank by its axle, and upon the side of the tank are mounted guides, and a traveler fitted with worm and change motion for traversing the traveler to and fro over the tank.

The traveler has a carrier attached, upon which are mounted burnishing-surfaces, such as agates or glass having a highly-polished surface—that is, a non-conducting

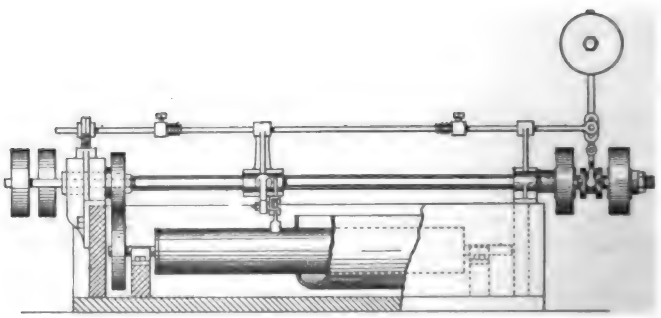


Fig. 2.—The Elmore Copper Depositing Process.

substance capable of burnishing and which is not acted upon by the electrolyte. The burnisher operates upon the surface of the deposited metal and a continuous motion of rotation is given to the core or mandrel receiving the deposit.

HINTS OF COMING TELEPHONE OPPOSITION.

With regard to the proposed cutting down in Utica, N. Y., of the unused wires of the Baxter Overhead Telegraph & Telephone Co., Mr. T. J. Griffiths, treasurer of that company, objects and says: "The wires are disconnected at both ends and could not lead a current to any point where it could do damage. It would be a great injustice to cut down these wires, for the Baxter company intends using them again, as soon as the Bell patents expire in 1893. The government has 300 instruments belonging to the company, stored in the government building; the batteries and all apparatus necessary to the business are intact and we shall be ready to do business within three months after the expiration of the patents. We shall furnish telephones at one-third the rental charged by the Central New York Company, with rebates according to the number of instruments used. The Baxter company owes between $6,000 and $7,000, and a few of us have been carrying it along with the intention of starting up again in 1893."

Sioux City, Ia.—The reconstruction of the Western Union's telegraph lines between Dubuque and Sioux City, a distance of 320 miles, has just been completed. A new wire has been run from Fort Dodge to Sioux City, and another from Le Mars to Sioux City. During the next month three new wires will be run between Dubuque and Sioux. The whole line is built of copper wire on 35 foot poles.

THE TOMMASI MULTIPOLAR STORAGE BATTERY.

The new system of accumulators invented by Dr. Donato Tommasi, of Paris, is distinguished by the peculiar form of the electrodes which are employed in place of the usual plates. The accompanying engraving, Fig. 1, shows the cell partly broken away, exposing the interior. Each electrode is formed of a perforated tube or folded sheet closed at one end by a small plate of insulating material into which is screwed a rod, as shown in Fig. 2, which shows one of the electrodes enlarged. The rod, which serves as a support for the tube electrode, is provided with a suspension head, which also serves as a contact. Instead of cylindrical tubes prismatic ones may be employed, as shown in Fig. 3, which utilize the space in the cells somewhat better than the former.

The grouping of the electrodes may be done in different ways, in lines or series, alternately positive and negative. The electrodes of one line are suspended by their heads in slots in the cover of the cell, and are introduced into the large aperture at the end of the slot and slid into place. In each accumulator the conductors which are let into the cover and upon which rest the electrodes of like sign are interconnected, as shown, so that the cover is provided with only two terminals, positive and negative.

In the annular space between the tube and the central conductor of each electrode the active matter, spongy lead or lead oxide, etc., is packed, so that the tube serves only as a support for such matter and can be made of any substance desired, so long as it is not attacked by the acid. Up to the present, lead and antimony-lead alloy have been used for these tubes, and the central rods have been given various shapes to increase their surface.

Among the advantages claimed by Dr. Tommasi for

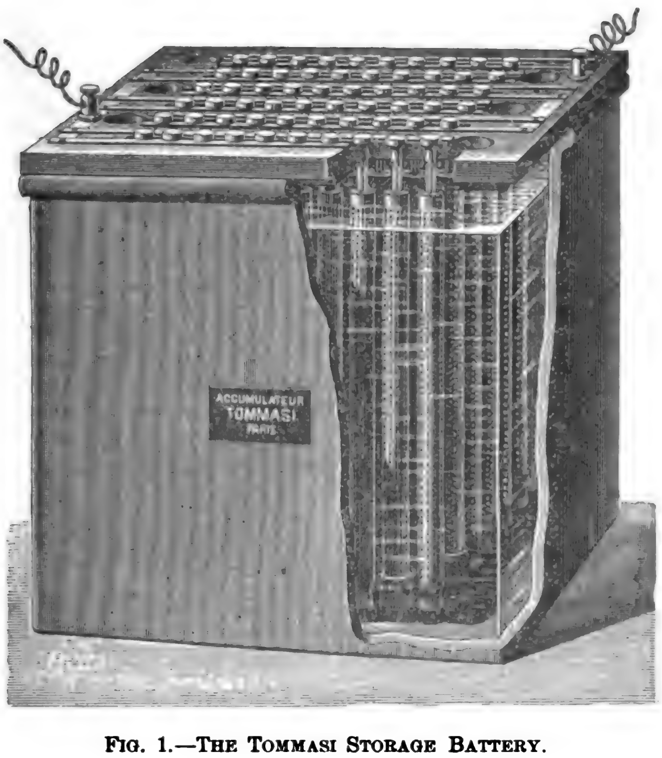
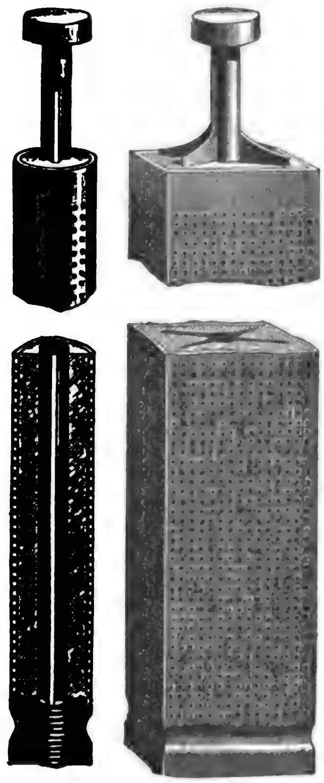


Fig. 1.—The Tommasi Storage Battery.

this type of cell are that the current passes entirely across the active material from the surface of the tube to the central rod, and *vice versa*.

For the formation of the electrodes very heavy currents can be employed without fear of loosening the material or of buckling the electrodes. The quantity of active material is made a maximum by the arrangement in tubes. On the other hand the chemical action of the current is uniform throughout the mass. As a result it has been possible to send currents of from 50 to 60 amperes per kilogram of electrode without involving the slightest displacement of the contents of the tubes. Of course these are not the conditions of actual practice, as with such heavy currents there is a heating of the entire mass; but the experiments prove that, practically, one can go very far beyond one ampere per kilogram, the usual rate of discharge in the ordinary type of cell. The multipolar accumulators having no soldered joints, no rupture need be feared and the electrodes can be removed one by one, even during the operation of the cell. The arrangement adopted also makes the cell very easy of transportation.



Figs. 2 and 3.—The Tommasi Storage Battery.

1. *La Lumiere Electrique.*

PRICES OF LIGHTS AND SUBWAYS IN NEW YORK.

The Gas Commission has rejected all the electric light bids submitted for street lamps. Should the 1,386 arcs be displaced, no fewer than 30,000 gas lamps would be required. It is hardly likely, however, that the commission will be precipitate in the matter.

In the meantime, the Consolidated Subway Co. has been prevented from turning over part of its work to the Empire City Subway Co., the Board of Electrical Control being enjoined from relieving the old company of any of its obligations. As a retaliatory measure, the Mayor has caused the subway rental rates to be fixed at $900 for 3-inch duct per mile; $800 for 2½-inch and $700 for 2-inch. The former rates were $1,000, $850 and $750. These rates are not satisfactory to the electric light companies.

BROADWAY AND NEWBURGH ROAD, CLEVELAND, O.

The Broadway and Newburgh road reports increase of its capital stock from $500,000 to $1,000,000. Its officers are Horace E. Andrews, president; John J. Stanley, vice-president and superintendent, and Edwin Fowler, secretary and treasurer. The company is operating its road on the Edison overhead system. It has 25 miles of track laid with the 82 lb. Johnson girder rail, and has 25 motor cars with 47 trail cars. The cars are of the Brill make. The Edison generators are run by three 300 h. p. engines from E. P. Allis & Co.

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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

VOL. X. NEW YORK, DECEMBER 17, 1890. No. 137

The neglected borderland between two branches of knowledge is often that which best repays cultivation.—Lord Rayleigh.

PRICES OF ELECTRICAL APPARATUS.

THE recent reductions in the price of electrical manufactures have already attracted some attention but not by any means that which they are likely to receive when the present financial stringency and disturbance settles back into normal conditions. The changes that affect a whole industry are necessarily of great interest, and they become the more important if they are of such a nature as to cause a radical and permanent readjustment of the market all along the line. The question that arises and becomes vital is: Are these lower prices abnormal, and of short duration, or are they to continue steadily so that every future arrangement must be made on their basis?

A brief editorial discussion of the prices of electrical goods in the *Boston Commercial Bulletin* shows us that the situation is not fully understood, even by such an authority on commercial and industrial subjects. Taking the recent reductions of price on Edison lamps and motors, it says: "If a reduction of 50 per cent. will leave them still a profit which they call that of a manufacturer, heretofore their profit on apparatus must have been over 100 per cent., and as all the companies sold electrical machinery for about the same list price, they must have all made approximately the same profit. The question now is what will the other companies do? Will they reduce their prices to meet the competition or lose business? As yet we hear of no large or even fair-sized company, making a reduction and we shall be obliged to wait for further developments. It seems as though we were to commence an era of lower prices for electrical apparatus. Prices have been reduced from time to time in the past and there still remains room for further reductions. It is an undeniable fact that years ago when the Brush Electric Co., of Cleveland, O., controlled the manufacture of electrical apparatus in this country, the company made over 300 per cent. profit on its dynamos, and competition gradually brought this profit down to its present basis." Now, it does not follow that the net profit heretofore has been either 100 per cent. or 300 per cent. It is to be remembered that during the ten years past, in which the electric light and power industry has taken shape, vast sums have been expended in experiments, patents and litigations. Those items of outlay have had to be counterbalanced, and hence almost up to the present moment, electrical manufacturers, especially the leading pioneers, to remain solvent, have had to figure them in their estimates of the cost of production, with a further allowance for the risk of the particular invention being superseded by something better that they do not control. In other words, electrical manufacturers have often not known what it cost them to make their product, and while prices have seemed high it has been evident after a time that they were actually not high enough if the business was to be carried on at a profit.

To a very appreciable degree, however, the electric light and power business has released itself from these earlier conditions, which constituted such an enormous tax on its earnings, and to-day the general position is as near that of a simple manufacturing industry as it is possible for anything so young and new to be. There is no necessity, then, to offer as an explanation, as the *Commercial Bulletin* does, that the Edison reduction has been made either to get free advertising, or to raise ready money, or to meet the competition of "a great many small companies that have started in the West to manufacture lamps and at a lower price." These, surely, are gratuitous assumptions in view of the regular tendency to reduction that has been seen for years. We have also heard it said that the reduction is largely due to the personal views and influence of one of the leading officials of the Edison Company. But even if that were true, as it well may be, it would only mean a readier perception in some quarters than others, in that company, that if Mr. Edison's intention of making "electricity as cheap as gas" were to be carried out, apparatus must be continuously made cheaper to the consumer, whether in central station or isolated plant. Gas and all its appliances are made better and cheaper than they were ten years ago, and certainly the evolution in electricity in becoming a staple necessity for the masses must be no slower. So far, then, from being casual or spasmodic, we take it that these reductions made by the Edison Company on one or two articles, are but the expressions of a well-defined, far-sighted policy that will not rest until its every product has been rescaled by the cost of its manufacture and the extent of an expanding market.

On the whole, therefore, we do not think that any action on the part of the great companies in lowering prices, as all of them have done at one time or another, need be explained by special causes or be looked upon with despondency. An experience of not a few years in this field teaches us that every reduction of a legitimate nature has been quickly responded to by a vastly enhanced demand. At the present juncture, the general contraction of business throughout the country, even though it be temporary, would have been accompanied by a check in electrical

growth, and this in turn would have limited sales, with consequent loss to both capital and labor. We are now very much inclined to doubt whether such restriction will be seen, and the tendency with lower prices is exactly in the opposite direction. In electric lighting, cheaper lamps will prove a stimulus, and the production of current, the main work of a central station, will be cheapened, with a brisker call for stationary motors. In street railway work, where already "electricity" is a synonym for "economy," there will be no falling off, with cheaper motors and generators; and our columns every week exhibit proof of the rapidity with which that department is growing. In short, amid all the unnecessarily higher and false prices that result from recent unwise tariff legislation, it is a pleasure to see that the electrical industries face the situation with firm values and on more solid ground of vantage than ever before.

THE LAW OF HYSTERESIS.

In the design of all alternate current apparatus, and especially in transformers, the loss due to hysteresis enters largely into the calculations, and is, indeed, the determining factor in the design of the modern transformer. The curves of Ewing have exhibited and proved in a graphic manner the rapid rise in hysteresis with increase in the density of magnetization, which has limited constructors of alternating apparatus to the use of magnetizing forces far below those generally employed in continuous current work. Up to the present, however, the law expressing the ratio of loss by hysteresis in terms of the magnetization has not been the subject of investigation, and hence the work of Mr. Steinmetz on this subject, appearing in our columns this week, deserves special attention. By subjecting a large number of observations of Ewing to analysis, Mr. Steinmetz finds that the loss by hysteresis may be very approximately expressed as varying in the ratio of the 1.6 power of the magnetization. The agreement between the observed and calculated values, as found by the law enunciated by Mr. Steinmetz, is so close that there appears to be little doubt left as to its accuracy, up to the limits, at least, of Prof. Ewing's observations.

INVENTING MADE EASY.

A paper of a very interesting nature—like all of those before the New York Electrical Society—was that by Mr. E. P. Thompson, of which we present an abstract in this issue. Mr. Thompson has long given special thought to questions of invention, in addition to those of patents, and his paper embodies a number of valuable hints and suggestions. While he does not claim that inventing can be made easy, he does assert that the gift of invention has been pretty liberally bestowed by nature, and that if some are endowed prodigally with the inventive faculty, others can develop their lesser talent up to the point of practical utility. The need of education and training is wisely emphasized. Very few, if any, instances of great inventions can be cited as being made by ignorant men, haphazard. The element of what we call chance may come in, but it is not determining. It was "chance" that took to Yonkers Mr. Eickemeyer, whose biography we publish this week, and chance, too, that led him to a study of hat making machinery. But he was already master of the principles of mechanism, and would as readily have invented in the paper making industry, had chance thrown him there.

Would-be inventors will do well to heed Mr. Thompson's advice to study the technical papers regularly. It will save them from much waste of time and money, and much re-inventing. It will also inform them of the lines of invention that are being most actively pursued. But they should seek out new fields for themselves. Inventors with all their originality are often like so many sheep, ready to follow any lead, whereas the fact that one master mind is exhausting any given department should be, primarily, a caution to let it alone. In electricity there is to-day abundant room for every inventor. It is all opportunity.

Storage Battery Work.

Notwithstanding the large number of modifications which the storage battery has undergone in detail of construction to adapt it more conveniently to particular purposes, or to increase its efficiency and durability, new forms are continually cropping up to demonstrate that there is still a field for profitable employment of inventive genius here. As evidence of this, we need only refer to two types of battery illustrated in this issue. In one of these, M. Reynier, working in the same lines as Mr. Dey, whose battery we described recently in these columns, provides in a single cell a combination having a difference of potential of 32 volts, and possessing in a high degree the properties of elasticity and freedom of motion of the plates without injury. In the other case Dr. Tommasi secures immunity from buckling, together with several other advantages, by dividing each plate, as it were, into a series of elements, which can be easily removed and inspected at any time. The data regarding the latter cell is still lacking, so that no comparison can yet be made between it and the other forms now existing. There seems also to be some room for improvement in the nature of the contact between the individual elements and the conducting strips at the top of the cell.

Slow Speed Motors.

There is an unmistakable tendency to the application of electric motors of a speed lower than that which has been generally employed up to the present. The reasons for this are apparent when we consider the fact that under ordinary circumstances a countershaft is required to transmit power from the high speed electric motor to the working shaft. For such work evidently the multipolar motor offers an easy solution, and it has been availed of recently by a number of well-known constructors. Among others Mr. A. L. Riker, whose motor he describes himself in another column, has devoted considerable attention to this department, and as a result he has combined in his machine a variety of novel features. The cross-connection of the segments of the commutator within the body of the same is a feature worthy of attention, as well as the general compact design of the machine. It will be noted also that Mr. Riker employs a toothed armature. Many modern designers are returning to this older type, which, at one time almost entirely discarded, is again coming into use with good effect, helped by the improvements effected as the result of experience.

JONES' MAIN OFFICE TELEGRAPH CIRCUITS.

In main telegraph offices where dynamos are employed as the source of current, it is very desirable to make speedy connection between the sending and receiving apparatus of a quadruplex or duplex system situated in the main office and the sending and receiving apparatus in a branch office

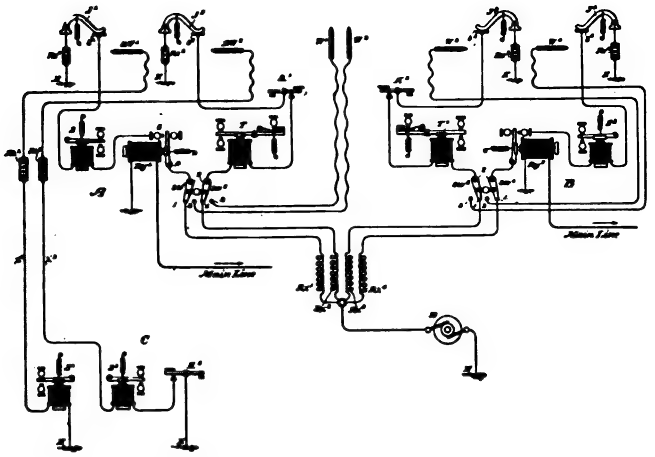


FIG. 1.—JONES' DYNAMO MAIN AND LOCAL CIRCUIT.

so that the operator in the branch office may be able to send signals through, and receive signals from, the quadruplex or duplex circuit as easily as if he were situated in the main office. To effect this and to admit of the easy and rapid connection of a single Morse circuit with a quadruplex or duplex circuit, as well as the automatic transmission of messages simultaneously from one duplex circuit to another, Mr. Frank W. Jones, the well known electrician and general manager of the Postal Telegraph Cable Co., has designed and put in operation the arrangement illustrated in the accompanying diagrams.

In Fig. 1, A and B indicate, respectively, two sets of duplex apparatus, or one duplex set and one side of a quadruplex set located in the repeating or main office, in their normal condition. C shows the receiving and sending apparatus at a branch office.

Assuming the dynamo D to have a potential of thirty volts and the local circuit *via* Rx', b', and J' a resistance of one hundred and fifty ohms—composed as follows, Rx', thirty ohms; S, twenty ohms; Re' and the other parts of

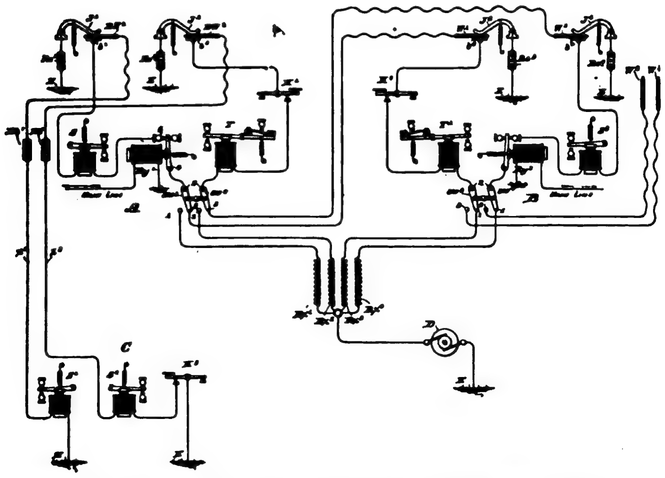


FIG. 2.—JONES' DYNAMO AUTOMATIC REPEATER CIRCUIT.

the circuit, one hundred ohms; total, one hundred and fifty ohms—then the electro-magnet S will be energized by a current of two hundred milliamperes when Ry' is closed at point 5, and similarly in respect to the other circuits *via* Rx^2, Rx^3, Rx^4. Should BW' be inserted between J' and the plate b', the movable part of J' and the resistance Re' will be thrown out of circuit by the insulated side of BW' and a new circuit will be established *via* b', the conducting side of BW', rheostat Rh' and wire x' through branch-office apparatus C to earth. It is obvious that if the resistance of Rh', wire x', and sounder S is additively equal to resistance Re', then the current flowing from the dynamos *via* Rx', S, and BW' to branch office C will be equal to two hundred milliamperes, and the electro-magnets now in circuit will be energized by the same strength of current as was S of the main office prior to the insertion of BW', and similarly of all the other local circuits shown.

In case it is required to connect the local circuits of set A with those of set B to form an automatic repeater, it is only necessary to turn the three-point switches sw' and sw^2, Figs. 1 and 2, of set A to the right, connecting the points 2 and 3, and then inserting wedge W' in spring-jack J^3 and W^2 in J^4, when the proper arrangement of circuits will be established, as follows: A circuit will be formed from earth *via* the dynamo D, Rx^3, sw^3, T', key K^2, contact-plate b^3, wedge W', *via* flexible cord to sw', points 3 and 1, thence *via* points 4 and 5 of Ry', sounder S, contact-plate b' J', and resistance Re' to earth, as shown in Fig. 1. In Fig. 2 the circuit above described is continued through wedge Bw' of flexible cord Rh' and x' to branch office and earth, instead of *via* Re' and earth, when BW' is not inserted. A similar circuit to that above describedwill be established *via* Rx^4,

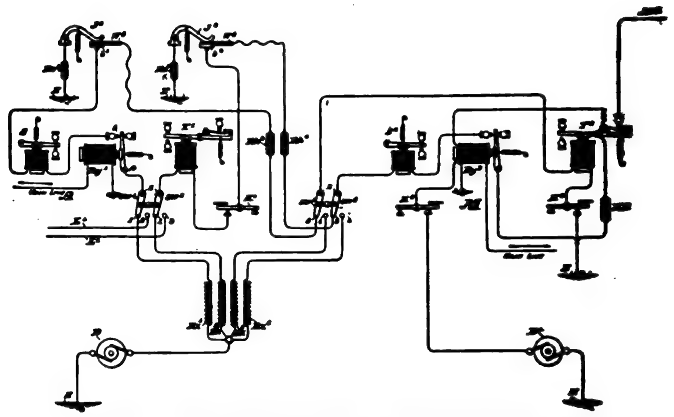


FIG. 3.—JONES' DYNAMO LOCAL DUPLEX CIRCUIT.

sw^4, Ry^2, S^3, b^4, and W^2 of set B, connecting with set A *via* flexible cord and sw^2, as will be readily understood by inspection of the diagrams. The resistance of these circuits as connected up in Fig. 2 will be somewhat greater than that previously assumed for various parts of the circuits, and the working-current will be less than before the insertion of W' and W^2, yet not sufficiently so as to render the electro-magnets inoperative.

Fig. 2 more clearly shows the connections described for the operation of sets A and B to automatically repeat into each other's main-line circuits through the mutual control of their local circuits, and the extension of their local circuits to earth at branch office C is shown on the left hand side. The dynamo circuits *via* Rx' and Rx^2 are shown open at sw' and sw^2, and the resistances Re', Re^2, Re^3, Re^4, are removed from their normal circuits by the insulated portion of the wedges.

Fig. 3 illustrates the apparatus and the necessary local connections employed for placing a single Morse circuit in connection with a duplexed circuit, or with one side of a quadruplexed circuit, at a repeater-station, so that the distant operator of the duplexed or quadruplexed circuit on one side of the repeater-station is enabled to transmit and receive messages to or from any station on the single Morse circuit on the other side of the repeater-station. During the time of the connection of the single with the multiple circuit, but one transmission of signals is possible either from the single circuit to the multiple circuit, or vice versa.

The single Morse circuit M L at M is shown in the diagram connected locally with a duplex set of apparatus at A in such a manner as to be capable of receiving signals from the duplex relay RY′ and of transmitting signals *via* the transmitter T of the duplex set without interference of one with the other in the well-known way. It will be understood that the distant operator on the duplex circuit keeps his key closed when desiring to receive signals from a Morse station on the single circuit in order that relay RY′ at A, Fig. 3, will remain in a closed position to hold transmitter F^3 closed to preserve the continuity of main line M L.

To restore the sets A and M to their normal or non-repeating condition it is necessary to remove W^5 and W^6 from J′ and J^2 and turn the three-point switches sw^5 and sw^6 to connect with their points 1 1 on the right. The local circuits of the single-line repeater M will then be supplied by currents from dynamo D *via* resistances Rx^5, Rx^6, as will be readily seen.

WOOD'S ELECTRIC METER.

Of the numerous principles applied to the purpose of an electric meter device, the heating property of the electric current has long been a favorite one, perhaps the best known meters in the class being the oscillating one of Prof. Elihu Thomson and that of Prof. Forbes. More recently Mr. J. J. Wood, the well known electrician now associated with the Fort Wayne Electric Co., has constructed a meter in which this principle is utilized in a very simple manner.

The engraving, Fig. 1, shows a front view of the meter, the construction of which will be readily understood from the diagram, Fig. 2. As will be seen, two very thin metal strips of fine wire A and A′ are rigidly fastened at the upper ends *a a* and at their lower ends to the short arm of

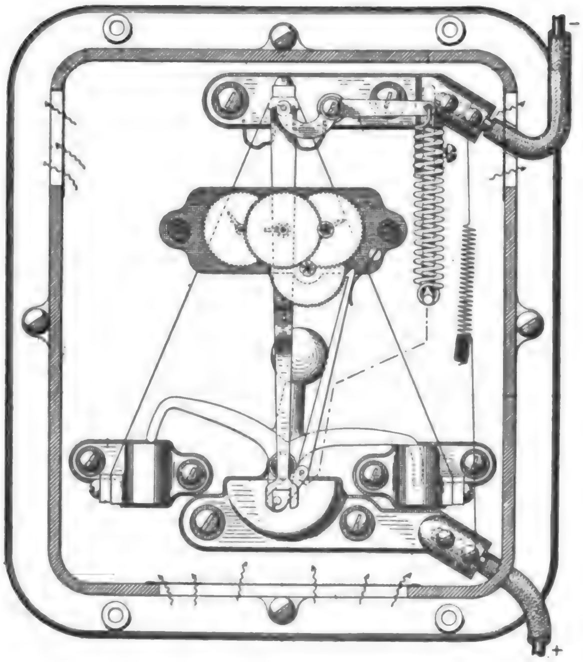


Fig. 1.—Wood's Electric Meter.

the lever B, the long arm of which terminates in a fork *c*′. The strips are maintained taut by the spring C, through the medium of the lever K.

The metal strips A A′ constitute high-resistance conductors for the electric current. They constitute also thermo-expansion devices, which by their differential expansion or contraction impart motion to the lever B. Thus, if an electric current of sufficient volume be sent through one of the strips—say, for example, the strip A—without being sent through the other, that strip will be heated by the current and will expand, while the strip A′, not being heated, will remain unchanged in length. The elongation of the strip A will relax the left-hand side of the short arm *b* of the lever, so that the tension of the spring C, acting against the middle of this boss, will tilt the lever and carry its arm *c* toward the left. The strip A′, thus constitutes a support for receiving the reaction of the lever, the

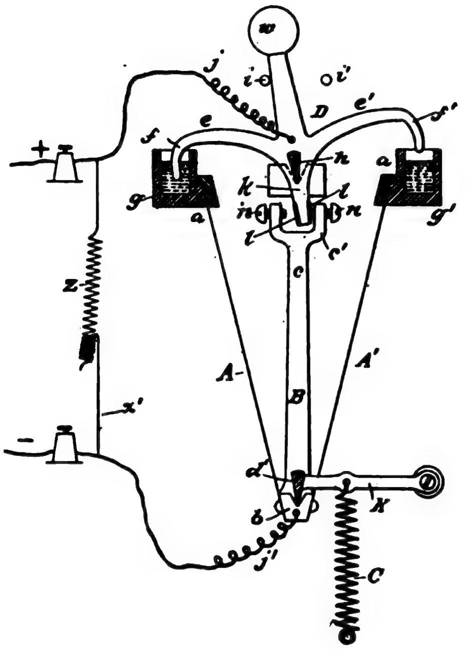


Fig. 2.—Wood's Electric Meter.

point of connection of its lower end with the right-hand side of the boss constituting for the moment the fulcrum on which the lever turns. The deflection of the lever will be directly proportional to the elongation of the strip A due to the heating effect of the current, since the strip A′, which is not heated by the current, is exposed to the same surrounding temperature as the strip A, so that whatever expansion or contraction is due to variations of external temperature or weather affects both strips A and A′ equally. The strip A′ thus becomes a compensating thermo-expansible support for receiving the reaction of the lever.

If upon the strip A reaching a certain temperature or having become expanded to a certain elongation the electric current is shunted through the strip A′ and cut off from the strip A, the strip A′ will become heated by the passage of the current and the strip A will simultaneously cool by radiation. The resulting expansion of the strip A′ and the contraction of the strip A will effect an oscillation of the lever B in the opposite direction, its arm *c* being deflected toward the right. Upon a certain deflection being reached the current can be again shunted back to the strip A, thereby again reversing the operation.

There results from these alternations in the path of the current a back-and-forth vibration of the lever B, which is utilized for imparting motion to the switch, by which the alternate shunting of the current is effected. These vibrations of the lever B occur with a frequency approximately proportional to the varying strength of the current, and they are utilized for the purpose of operating the recording or totalizing mechanism, which accordingly affords a correct indication of the total current which has traversed the instrument during a certain time.

The switch which effects the alternations in the current is quick acting and as an additional safeguard against arcing upon the change of current in the C strips, contact in one mercury cup is made before that in the other is broken.

NEW FORT WAYNE PRIMARY FUSE BOX.

One of the first requisites in any attachment to an electric circuit carrying a high tension current is safety in handling, especially in that class of apparatus which from its nature is apt to require attention at more or less frequent intervals. Among the latter the fusible cut-outs

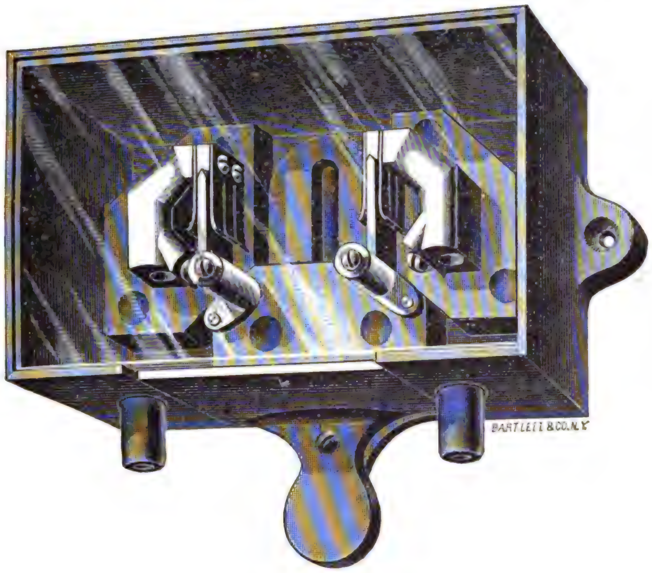


Fig. 1.—New Primary Fuse Box.

frequently require replacement when they have been blown, and when in circuit with high tension wires the arrangement ought to be such that the fuse can be replaced without danger to the attendant. In seeking to secure such safety the Fort Wayne Electric Company have recently

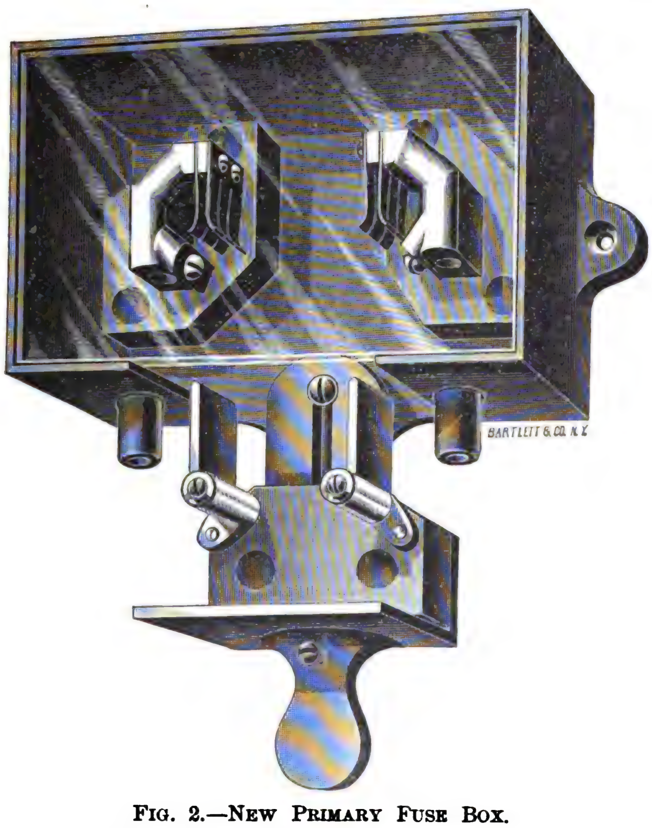


Fig. 2.—New Primary Fuse Box.

brought out the primary fuse box illustrated in the accompanying engravings.

As will be seen in Fig. 1, it consists of a cast iron box covered with a glass plate. The circuit, which enters from below through insulating bushings is connected to binding posts provided with spring clips. Between these clips two tongues make contact and thus close the circuit through the fuse wire. When a fuse blows, the attendant, by releasing the screw shown in the handle at the bottom, frees a slide which, upon being pulled out, withdraws the tongues from between the spring clips and thus breaks the circuit at two points. He is then enabled to insert the fuse with perfect safety and when finished pushes the slide back into place, which automatically restores the continuity of the circuit.

It will be evident that by this arrangement the replacing of the fuse cannot be accomplished without first breaking the circuit, so that entire immunity from accident is insured.

MAGNETISM AND RECALESCENCE.[1]

BY J. HOPKINSON, D.SC., F.R.S.

In my experiments, the results of which are published, "Phil. Trans." 1889, A, p. 443, I showed that recalescence and the disappearance of magnetizability in iron and steel occurred at about the same temperature. The evidence I then gave was sufficiently satisfactory, but did not amount to absolute proof of the identity of the temperatures. Osmond has shown that the temperature of recalescence depends upon the temperature to which the iron has been heated, also that it differs when the iron is heated and when it is cooled. He also showed that for some sorts of steel the heat is liberated at more than one temperature, notably that in steel with 0.29 per cent. of carbon, heat is liberated when cooling at 720° C. and at 660° C., and that with steel with 0.32 per cent. carbon there is a considerable liberation of heat before the temperature is reached when this becomes a maximum. It appeared to be desirable to obtain absolute proof that the change of magnetic property occurred exactly when heat was liberated and absorbed, and to examine, magnetically, Osmond's two temperatures of heat liberation. I have not been able to obtain samples of steel of the size I used, showing two well marked temperatures of heat liberation and absorption, but I have a ring in which there is liberation of heat extending over a considerable range of temperature.

The samples had the form of rings. A copper wire was well insulated with asbestos, and laid in a groove running round the ring, and was covered with several layers of asbestos paper laid in the groove. This coil was used for measuring temperature by its resistance. The whole ring was served over with asbestos paper and with sheets of mica. The secondary exploring coil was then wound on, next a serving of asbestos paper and mica, and then the primary coil, and, lastly, a good serving of asbestos paper was laid over all. In this way good insulation of the secondary coil was secured, and a reasonable certainty that the temperature coil took the precise temperature of the ring, and that at any time the ring was throughout at one and the same temperature. The whole was placed in an iron pot, and this again in a Fletcher gas furnace. Observations were made of temperature as the furnace was heating, and from time to time of induction. In each case the time of observation was noted. Similar observations were made as the ring cooled, the furnace being simply extinguished. We are thus enabled to compare directly at the same instant the condition of the same ring as regards magnetism and as regards temperature, and, therefore, qualitatively as regards its absorption or liberation of heat.

These experiments show that the liberation and absorption of heat, known as recalescence, and the change in magnetic condition, occur simultaneously. Also that in the case of steel with 0.3 per cent. of carbon both temperatures of liberation of heat are associated with change of magnetic condition.

OVERHEAD TROLLEY WIRES A GOOD THING.

President G. B. Roberts, of the Pennsylvania Railroad Co., has come out strongly for overhead wires for electric street railways. Speaking of the statement that the overhead wire system was dangerous President Roberts said:

"I don't believe as many horses are killed or hurt by overhead wires as on this asphalt pavement around the City Hall; but for that reason we would not replace that pavement. More people are killed in London by slipping on orange peels than by railway transportation accidents in all England. Really and seriously, all the dangers of overhead wires are so slight that they are overbalanced by the advantages, and we must take some risks in every enterprise. I have no interest, not a penny, in this system. I should grant every road overhead wires without reference to the dangers."

The Rapid Transit Commission has declared in favor of overhead wire roads west of the Schuylkill, north of Columbia avenue, and south of Washington avenue, Philadelphia.

1. Abstract of a paper read before the Royal Society.

NOTE ON THE LAW OF HYSTERESIS.

BY CHAS. STEINMETZ.

The magnetism of a magnetic circuit will vary periodically, if subjected to a periodically varying magnetomotive force. The variations of the magnetism, however, will not be simultaneous with the variations of the magnetomotive force, but show a certain lag, so that the curve of magnetism, as a function of the magnetomotive force, forms a kind of loop, the well known curve of hysteresis.

This phenomenon proves, that in the production of the magnetic circuit by the conversion of electric energy into magnetic energy, and in the destruction of the magnetic flow by its reversion into electric energy, a certain amount of energy has been lost, that is, converted into heat.

The amount of energy converted into heat by hysteresis in a full magnetic cycle depends on the maximum magnetization. It increases with increasing magnetization, but faster than the magnetization, so that, when for a magnetization of $\mathbf{B}=3{,}000$ (3,000 lines of magnetic force per square centimetre) the loss by hysteresis amounts to 736 absolute units or ergs per cubic centimetre (10^7 ergs=1 watt-second); for four times as high a magnetization, or $\mathbf{B}=12{,}000$, the loss is 6,720, that is, more than nine times as high. On the other hand, the loss increases more slowly than the square of the magnetization, because the square law would require a loss of 11,776 for $\mathbf{B}=12{,}000$.

A great number of experimental researches on the loss of energy due to hysteresis, with different magnetizations, have been made by Ewing; but that law of nature is still unknown, which gives the dependence of the hysteresis upon the magnetization.

In trying to find at least a clew to this law, I subjected a very complete set of Ewing's observations on the hysteretic energy, made on a soft iron wire, and consisting of ten tests from a magnetization of 1,974 lines of magnetic force per square centimetre, up to 15,560 lines per square centimetre, to an analytical treatment by the method of least squares, to ascertain whether the losses due to hysteresis are proportional at all to any power of the magnetization, and which power this is.

The results of this calculation seem to me interesting enough to publish, in so far as all those observations fit very closely the calculated curve, within the errors of observation, and the exponent of the power was so very nearly 1.6, that I can substitute 1.6 for it, and combine those observations of Ewing in the formula

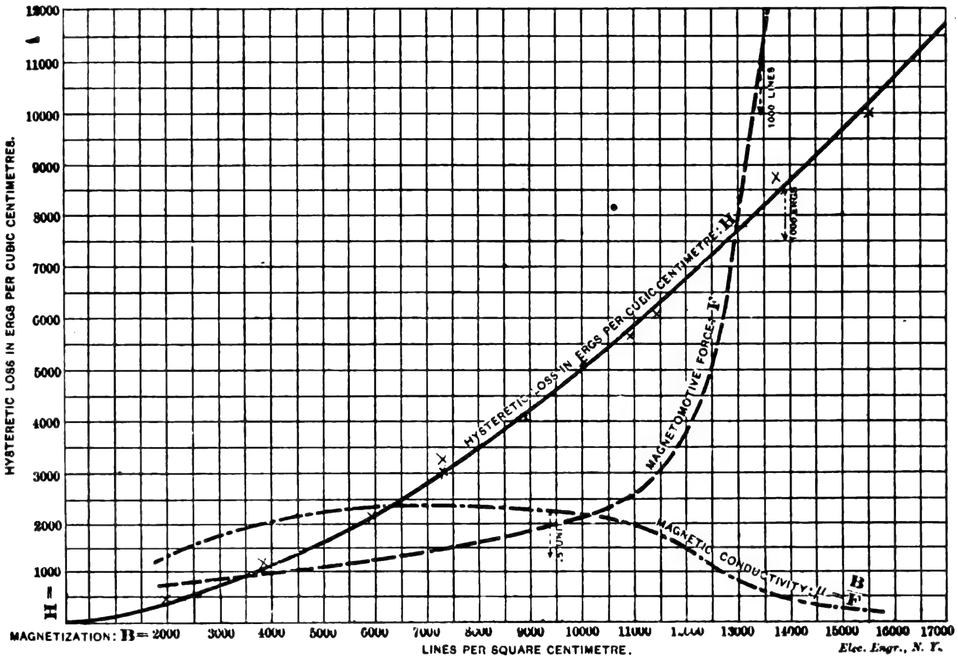
$$\mathbf{H}=.002\ \mathbf{B}^{1.6},$$

where $\mathbf{H}$ is the loss due to hysteresis, in ergs per cubic centimetre ($=10^{-7}$ watt-second) per cycle, and $\mathbf{B}$, the maximum magnetization (number of lines of magnetic force per square centimetre).

In Table I., in the first column, are given the values of the magnetomotive force $\mathbf{F}$, in absolute units; in the second column is given the maximum magnetization or induction, $\mathbf{B}$, in lines per square centimetre; in the third column the magnetic conductivity $\mu=\dfrac{\mathbf{B}}{\mathbf{F}}$; in the fourth column the hysteretic loss $\mathbf{E}$, in ergs per cubic centimetre, as observed by Ewing, but in the fifth column the hysteretic loss calculated by the formula:

$$\mathbf{H}=.002\ \mathbf{B}^{1.6}.$$

The sixth column gives the differences of the observed and the calculated values, $\mathbf{E}-\mathbf{H}$; the seventh column gives these differences in per cents. of $\mathbf{E}$.



Loss by Hysteresis at Different Degrees of Magnetization.

In the diagram these calculated values, $\mathbf{H}$, of hysteretic loss are shown in the curve; the black crosses show the values of hysteretic loss $\mathbf{E}$ observed by Ewing.

For comparison there are shown, in dotted lines, the curves of magnetomotive force $\mathbf{F}$ and of magnetic conductivity, $\mu=\dfrac{\mathbf{B}}{\mathbf{F}}$, as functions of the magnetization $\mathbf{B}$.

It will be seen that the observed values of hysteretic loss are very near the calculated curve through the whole range of observation, and do not show any tendency to deviation, which justifies my considering this coincidence as something more than a mere accident, and, indeed, as an indication of a general law, although certainly this law might be more complicated than the formula.

In Table II. are given the values of hysteretic loss, calculated by the formula:

$$\mathbf{H}=.002\ \mathbf{B}^{1.6}.$$

To one interesting fact I wish to draw attention: The hysteretic loss seems to be independent of the magnetomotive force $\mathbf{F}$, and only dependent upon the magnetiza-

tion **B**; it therefore shows no special singularity at the point of the beginning of magnetic saturation, but increases in the last two observations in Table I., which, for an increase of **B** by 3,500, require an increase of **F** by 68, showing high saturation, according to the same rule as in the first eight observations, where $\mathbf{B}=12{,}000$ corresponds to $\mathbf{F}=7$. Therefore the "knee" of the magnetic curve or "characteristic,"

$$\mathbf{B}=f\ (\mathbf{F}),$$

is no singular point of the curve of hysteresis $\mathbf{H}=.002\ \mathbf{B}^{1.6}$, as the diagram shows.

From this formula we get the loss due to hysteresis per cubic inch of soft iron and for the maximum magnetization of M lines of magnetic force per square inch, when n = the number of complete periods of the exciting alternate current:

$$\mathbf{H} = \tfrac{5}{8} \times 10^{-10}\ n\ M^{1.6} \text{ watts.}$$

TABLE I.

Comparison of Ewing's observed values of **E**, the energy consumed by hysteresis in soft iron, with the values calculated by the equation:

$$\mathbf{H}=.002\ \mathbf{B}^{1.6}.$$

F	B	μ	E	H	E–H	Diff. in %.
1.50.	1,974.	1,330	410.	375.	35.	8.5%.
1.95.	3,830.	1,964	1,160.	1,082.	58.	5.0%.
2.56.	5,950.	2,324	2,190.	2,190.	0.	.0%.
3.01.	7,180.	2,385	2,940.	2,956.	–16.	–.5%.
3.76.	8,790.	2,340	3,990.	4,080.	–90.	–2.3%.
4.96.	10,590.	2,133	5,560.	5,510.	50.	.9%.
6.62.	11,480.	1,734	6,160.	6,260.	–100.	–1.7%.
7.04.	11,960.	1,700	6,590.	6,690.	–100.	–1.5%.
26.5.	13,700.	517	8,690.	8,310.	380.	4.4%.
75.2.	15,560.	207	10,040.	10,190.	–150.	–1.5%.

TABLE II.

Energy consumed by hysteresis, in absolute units $(=10^{-}$ watt-seconds) per cycle and per cubic centimetre soft iron, for the induction of **B** lines of magnetic force per square-centimetre, calculated by the equation:

$$\mathbf{H}=.002\ \mathbf{B}^{1.6}.$$

B	H	B	H
1,000	126	11,000	5,850
2,000	382	12,000	6,720
3,000	736	13,000	7,640
4,000	1,160	14,000	8,600
5,000	1,658	15,000	9,610
6,000	2,220	16,000	10,660
7,000	2,840	18,000	12,870
8,000	3,520	20,000	15,230
9,000	4,240	25,000	21,760
10,000	5,020	30,000	29,280

THE EDISON GENERAL ELECTRIC CO.'S ELECTRIC PERCUSSION DRILL.

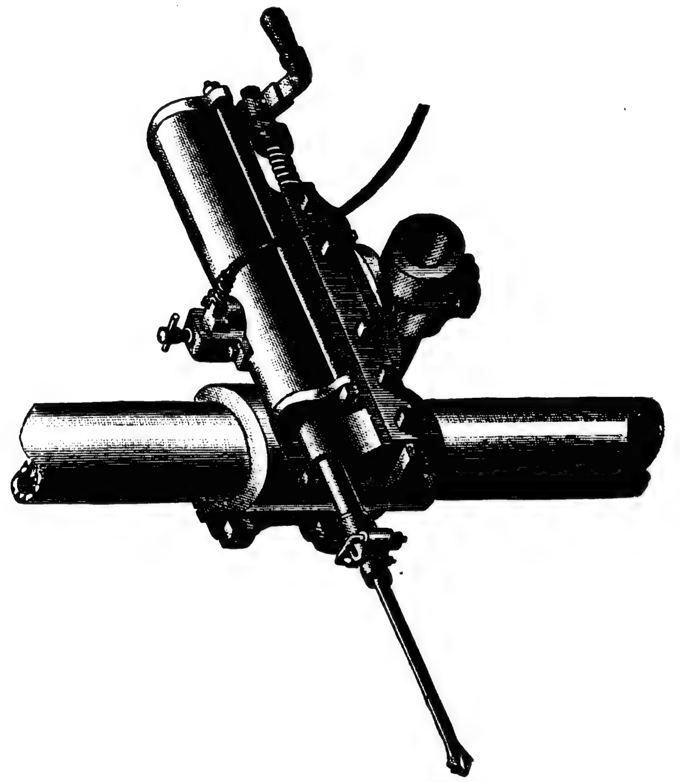
THE one thing which has more than anything else prevented the all but universal application of electric motive power to mining operations, has been the lack of an efficient and practical electrical substitute for power drills operated by steam or compressed air.

The Edison General Electric Company, appreciating this fact, have obtained control of and are now manufacturing and exploiting a drill making use of the principles of the "Marvin system of percussion tools." This drill, a cut of which is here shown, consists simply of a reciprocating iron bar impelled backward and forward by the action of two solenoids which are alternately thrown into action by pulsating electric currents.

This alternate action of the two coils is accomplished without the aid of commutators, collectors or other moving parts on the drills which are involved in reciprocating motions in other machines, but is accomplished by the use of pulsating currents, positive impulses being delivered to one coil and alternately negative impulses to the other. Since there are no moving parts in the drill except the reciprocating bar or plunger, there is no wear except in the guides. The heaviest parts of the drill are the tripod weights which weigh about 100 pounds each, and the two solenoid coils which weigh 55 pounds each; and the largest piece is the cylindrical casing in which are enlosed the coils, which is 38 inches long by about 6 inches in diameter. The total weight of drill and tripod is about 400 pounds.

The drill makes about 600 strokes per minute of a maximum length of about 4 inches and will cut at the rate of two inches per minute in the hardest granite with a one and one-half inch bit, with a consumption of about 5 h. p.

One of the most remarkable features of this drill is that



MARVIN ELECTRIC DRILL.

should the machine not be fed up to the rock properly, so that the bit fails to strike, the plunger immediately loses its stroke and its motion drops to a mere quivering action of about one inch travel. The plunger is automatically cushioned by the magnetic action of the coils and vibrates in space without striking anything at either end of the stroke. The machine cannot therefore injure itself while thus running free.

It may also be forced hard against the rock so that it cannot take its stroke, and left in this situation with the current on indefinitely without injury and with little waste of energy, as the power absorbed by the drill is automatically proportioned to the work it does. It is practically impossible to run the machine in such a way as to injure it.

The drills are run in parallel. The current, which is pulsating, is derived from a generator exactly similar to the standard Edison dynamo, except that it is supplied with pulsating current collectors, in addition to the regular commutator. The machine is thus self exciting and allows of continuous current apparatus being run on a separate circuit from it, at the same time that pulsating currents are delivered to the three wires leading to the drills.

HOW TO MAKE GREAT ELECTRICAL INVENTIONS.[1]

BY EDWARD P. THOMPSON.

The author of the paper discussed at the outset the methods by which a would-be inventor should address himself to his work. Any given individual, he said, takes a step toward becoming or improving himself as an inventor who studies the need of the public; learns the difficulties connected with that department of art or industry in which the need exists; excites his mind with the belief that he can provide means to remove the difficulties; and proceeds with diligence toward the solution of the problem.

The truth of this problem is strengthened by its negative aspects. Suppose the first step should be, *not* to study the need of the public. The consequence would follow in many cases, in the production of useless inventions; *i.e.*, those which accomplished results not wanted. This often does occur. As an illustration may be mentioned, parlor skates. An inventor of an improved parlor skate for to-day is an inventor of that which has no market, as skating rinks have gone out of fashion and lost their popularity. It is something which the public does not want, even though they did pay a tribute of many thousand dollars to the first inventor of the parlor skate.

The second element of the principle before stated consists in learning the difficulties connected with that department of art or industry in which the need exists. If there is any one difficulty in connection with any department of art, the would-be inventor may be sure of reward if he succeeds in overcoming the difficulty. How is he to become aware of the difficulty. He is to make a business or study to this end. If he is engaged with a manufacturer he can daily become acquainted with difficulties which prevent the manufacturer from clearing as much profit as he should. If he is a student or scholar of science he can become acquainted with difficulties by studying any particular art. If he is a business man, he can learn difficulties by the habit of observation of difficulties met with by himself. In connection with his own business, any man can in the course of at least a week learn some difficulty if he will only keep his wits about him and be on the lookout. He may meet it in traveling, in business, in his home, in his conversation with others, in the newspapers and in other directions. At the present moment exist problems well known to many, but yet unsolved, and of all degrees of magnitude and in all departments of every art.

Mr. Thompson here instanced such promising fields of work as alternating current motors, electrical storage, conversion of electricity into heat and *vice versa*, the storage of light, new light giving media, transmission in fac-simile; mail transportation by electricity; new electrical generators, electrical watches, electric meters, commutatorless dynamos, cheap aluminum.

Discussing the hindrances to the progress of invention, Mr. Thomson said: Some are desirous of being inventors. They know they have a taste that way. They admit that there is room for improvement and for original invention. They have studied the principles of science or of a particular art. They believe that others may and will invent. Ask them why they do not invent. The invariable reply is that they believe they possess no genius or inventive faculty. They imply that some have been born and gifted with what they have not. This is not true. Every man has more or less power of inventing. Every day every one busily occupied, uses his power of faculty of inventing, when he plans, in imagination, his business of the day, or whenever he thinks of the best way of carrying out an idea. Let one once believe that he does possess the power to invent and it will not be long before he will know that the field of invention is shut against none. A friend once told me he could never invent any new and useful device, because he believed that he had no genius. I undertook to prove that genius was a latent power in all and could be brought out by a voluntary action on the part of the mind, and that the creation of a conception depended vastly more upon systematic thought, knowledge, and a determination to invent than upon the vague myth called genius. Within one month thereafter, the same person came to me with a complete conception which became a successful physical invention, original in a patent sense and highly commercially valuable and practical. From observations of a similar nature I conclude that the following principle is true: A belief of an individual that he himself does not possess genius or the power to invent, is in itself a hindrance to the action of that power.

The corrollary which follows is: An individual who will admit that he possesses a power of inventing to a greater or less extent may become an inventor by the proper use of his knowledge. Suppose that the inventor of the device for threading needles insisted previously upon the assumption that he had no genius. He did not so assume. Consequently he received an annual income of $10,000 from the sales of his patented needle threader, which was at one time so popular a device. The inventor of the roller skate cleared nearly $1,000,000, although during only the last few years of the term of the patent. Neither did he make the invention until after many days of intense thought.

Will any civilized white man assume he has no inventive faculty or genius when it is a fact that the patent office records show that colored men are inventors. I am personally acquainted with a colored man who has not only made electrical inventions and received letters patent of the United States, but has sold the same. His extreme confidence in his ability to invent, is easily apparent to those who know him. Some of his inventions are now in use and show a high type of invention; therefore it seems but proper that due honor should be given by mentioning his name. I refer to Granville T. Woods, of Cincinnati, Ohio.

With regard to the difference in the nature and scope of inventions, Mr. Thompson said:—

A radically new invention is properly called a generic invention because it prefaces successive specific or derived inventions. As an example of a generic invention may be mentioned the method of transmitting speech electrically. Since 1876, the date of that invention, numerous specific inventions have been made, patented and put into practical use with profit to the inventor. As an example of a specific invention, may be mentioned the Edison-Blake transmitter, without which telephony may easily have become extinct. This transmitter magnifies the sound so that users are not troubled by inaccurately transmitted speech as before the introduction of the wonderful but simple carbon transmitter. As another illustration of generic and specific invention may be named the original phonograph, while all subsequent improvements, modifications, mostly made by the original inventor himself, are specific inventions.

The first steam engine is a generic invention, while all later are specific. The first chemical battery is a generic invention. All others are specific. The first dynamo is generic; subsequent dynomos are specific. The first telegraphic message was sent by a generic invention. Subsequent improvements, modifications, etc., are specific.

From investigation of the inventions of the two classes, it is discovered that all generic inventions are made by the application of purely scientific principles and specific inventions sometimes in the same manner, but oftener by the application of the principles of mechanics than by those of pure science.

As an illustration of the production of a generic invention take the case of the arc lamp. Before its invention, the principle was known that momentary light is produced by interrupting an electric current. The inventor effected an artificial permanent light by applying this principle. By experiment he found that the light or spark gradually consumed the electrodes. He provided means for forcing together the electrodes as fast as they were consumed, and he thus produced one of the most useful inventions of to-day.

The following principle of the science of invention holds true in reference to all past generic inventions and it may, therefore, be assumed to hold true for all future generic inventions. It is formulated thus:—A generic invention may be made by combining one or more principles of physical, electrical, or chemical sciences to a new and useful purpose. The corrollary to this is:—Any given problem of generic invention may be solved by becoming acquainted with the principles of physics, electricity and chemistry, and then searching for principles which by their combination will produce the result sought.

Both of these principles prove the preference and almost the necessity of thorough scientific education on the part of the inventor. I believe it would be for the good of the industrial arts and the public to establish in our various scientific colleges, a class for the development of the power of inventing. At present, students study science and store it away in their brains as though the storage was to be permanent. By the time they undertake to use the knowledge, they have forgotten most of it.

Mr. Thompson advised his hearers not to be discomfited by "anticipations," which should only be an incentive to further effort. At the same time he cautioned against working on evidently played-out lines. "I do not intimate," he said, "that any one here is undertaking impossibilities, but they may be wasting time in a path in which others for scores of years have failed. I mention as an example thermo-electricity by contact of different metals. Give it up! but if you wish to work on this subject in general, try the solution of conversion of heat into electricity in some other line than by the contact of different metals. Clamond spent thirty-five years on this subject with scarcely any improvement over his predecessors."

With regard to simultaneity of invention, Mr. Thompson remarked that inventors could not be too careful and quick in having their inventions properly described and attested "even if they do not apply for a patent immediately. The drawings and descriptions of the first mental inventions should be signed, witnessed and executed before a notary public if possible, on the day of conception." But, he added: "Do not trust to accident nor to inspiration nor to any mythical spirit or genius to make your invention for you. Do not expect the invention to come to you without any exertion on your part. For thirty years, the electric motor was known, but was not operated by power to obtain a current. For thirty years the red lead and litharge occurred on the lead plates after discharge. Obtaining with a view to invention an accurate knowledge of the scientific nature of the elec-

1. Abstract of a paper read before the New York Electrical Society, December 10, 1890.

tric motor and of the early secondary battery was the factor which made the respective inventions." Moreover, "as soon as any one, either by investigation, alone or with the assistance of a chemist or physicist, or as soon as a scientist or any individual announces a scientific fact or principle not known before, embrace the opportunity of being the first to apply the fact or principle to a useful purpose. In reading periodicals or scientific papers have this rule of invention in view. Look out for the results of scientific investigation, not as a student who simply reads as a matter of obtaining knowledge, nor as a critic, nor as a pastime, but for the single and concentrated purpose of being the pioneer in the application. As soon as Faure made his invention there were scores of immediate and independent inventors, who conceived the improvement of compressing the active material into small cells or perforations in the lead plate for the two-fold advantage of obtaining more metallic surface, and of retaining the active material in its proper place, since if applied to a flat lead surface, it is apt to fall off gradually but surely. I have found that the least number who made this invention and are continuing to make it may be estimated at about one hundred and twenty-five. Some one was of course the first, but it makes no difference here who it was, but as I remember, the United States Courts have decided n favor of Charles F. Brush. The question is sometimes asked by the thoughtless, of what use is it to spend a fee to belong to an electrical society or to be a subscriber to a scientific paper, or to study the numerous patents granted? The man who wishes to be a successful inventor, cannot afford to despise such things.

"The history of the invention of the carbon transmitter strengthens this principle of invention. In 1878 Edison discovered the scientific principle that all semi-conductors have the property of varying the current according to the pressure. Four years later, when inventing in the subjects of telephones he recalled the new knowledge and by introducing semi-conductors into a circuit and talking against them he thereby applied the new knowledge to a useful purpose."

On the subject of "Simplicity as the Result of Specific Invention," Mr. Thompson said:

"It is a remarkable principle that the final type is simpler in construction than the generic invention and that simplicity detracts from originality. The first telephone transmitter was more cumbersome and costly than the present; while the first envelope machine was as confusing in appearance as the wisps of hay in a hay stack. Many men wonder why they could not have invented the telephone. They should be reminded of two things; they either did not try or else they think that the first unsuccessful telephone was as simple as the present. Bell's earliest telephone was for transmitting music and its construction was as intricate as a piano or typewriter. Nearly every generic physical invention is of low efficiency, complex and intricate in construction and tending very much to drive the inventor into despair. If he has evidence that he is on the right track he should not stop for such difficulties by abandoning the invention and finding afterwards that others commenced where he left off and brought out a successful commercial article. It is far better as a last resort to get the assistance of another inventor at the expense of a portion of the interest in the patent and act thereby in accordance with the old proverb that two heads are better than one."

The important question of experimenting was not forgotton. "Different inventors," said Mr. Thompson, "follow different paths in the process of inventing. In some cases they perform experiment upon their conceptions. One experiment leads, in their mind, to another with new suggestions, until finally they are able to decide upon the fact of the invention as to whether it is operative or not. This is the most economical method. It in itself trains the mind to the power of intense imagination and power of invention. Many preliminary experiments may often be dropped by studying books on the subject to discover just what facts and principles exist that bear on the subject in hand. Many inventions have been made successful upon completion of the first device. A pencil and piece of paper will greatly aid the imagination and will save much useless experimenting. This method of inventing is followed mostly by highly scientifically educated persons, such as professors of the sciences at colleges. I lately visited at his home an inventor of a 'Put a Nickel in the Slot and Have Your Photograph Taken.' The machine did all the work. It was automatic from the beginning to the end of the process. Although mavellous to behold and apparently intricate, it was the result of the very first experiment, and it did its work not only well, but every time. I found that it took but two months for him to reduce the mental invention to the physical; but to devise the complete mental invention, and to experiment with all the movements in the mind, assisted by pencil and paper, occupied the larger portion of a year.

"Some begin to experiment upon the very first conception, and even build a full sized machine or apparatus at the first, and when the difficulties are found, another machine is built, and so on. This method is more expensive and requires more time, and does not in itself increase the power of imagination, which is one of the greatest aids to an inventor. A harmonious blending of these two methods makes the greatest inventor.

"The style followed by the chemist and physicist in their experimenting for new principles, is often copied by successful inventors. The former use small and almost minute quantities and apparatus costing very little. Small experiments are positive and often more so than large experiments. Planté experimented upon his secondary battery with small quantities of chemicals costing but a few cents each. Distribute your time and money on numerous small experiments rather than upon a few large ones.

"Experimenting for the purpose of solving a certain problem often leads to the solution of an independent and unexpected problem. Glauber searched long and diligently for the philosopher's stone, and by putting certain chemicals together for this purpose found that he obtained a substance radically different from either of the constituents. The compound thus produced is the medicine which bears his name."

THE PRESENT STATUS OF STORAGE BATTERY TRACTION.[1]

BY PEDRO G. SALOM.

Just at a time when so much interest is being manifested by the public in relation to the discussions before councils on rapid transit and electric traction, it is pertinent and but simple justice to the public that they should know the exact status of storage battery traction.

This much abused system, which has never yet had a fair and untrammelled trial in this country, but which, nevertheless, is bound to supersede in the near future all other systems of electric traction in large cities (whether overhead or conduit), asks to be heard on the following grounds:

First. It is admitted that a storage battery car will run well even under unfavorable and difficult conditions.

Second. That the mechanical construction from the motor to the wheels is practically the same (and can be made, if desired, exactly the same) as the now generally admitted successful overhead system.

Third. This being the case, if it can be shown that a certain weight of battery, at a given price, can propel a car a given num- of miles, and that the cost for battery in doing this work does not exceed a certain maximum fixed price, which, together with the other operating expenses, is less than the cost per car mile with horses, then it must be evident to the dullest comprehension that there is a field for storage battery traction.

The question is entirely one of horse-power. Either a certain weight of battery will return a certain number of horse-power hours as effective work after being charged or it will not. The proposition in paragraph 3 is either true or false and is capable of verification by any well qualified electrical or mechanical engineer. The gentlemen engaged in the development of storage batteries are neither fools nor charlatans, and the company which I have the honor to represent court the most rigid and exhaustive investigation as to the truth of their statements.

If, for example, a commission composed of such men as Mr. Coleman Sellers, Professor Rowland, Dr. Dudley, and Professor Barker pronounce on this question as to the ability of the battery to perform such work for such a price, it must forever remove the question of uncertainty and doubt hanging over the system at the present time.

We are now prepared to prove, and to guarantee under proper conditions, that the cost per car mile for renewals shall not exceed a certain maximum rate per mile based on the amount of work required for any given installation.

The fact that certain individual installations of two or three cars have failed to be commercial successes proves nothing, except, perhaps, that they are badly designed to accomplish the work required. No one would condemn a locomotive for failure to run from New York to Chicago without receiving additional fuel and water above that of the initial charge. Therefore, if in a certain case a car fails to run, say, twelve miles on time, assuming that the mechanical equipment is right, it shows either that the type of accumulator used is too small, or, that there is an insufficient number of them to do the work, both of which are mechanical errors that can be easily overcome in designing new cars in the future.

The overhead system, by reason of its simplicity, received the generous support of capitalists, notwithstanding the fact that all the early installations were absolutely commercial failures, and even Siemens & Halske, probably the foremost and oldest established electrical engineers in the world, were so discouraged by their numerous and expensive efforts to make electric traction other than the storage system a success, that they abandoned all hope of ever doing so until the recent achievements of American engineers in that direction revived their early expectations.

Moreover, even if the overhead system gains a temporary advantage by being introduced at the present time, the street railway company will be forced by the inevitable logic of events to adopt the storage system in the future. Those who are clamoring loudest for overhead traction to-day will ultimately be the most earnest advocates of storage battery traction.

1. Letter to *Philadelphia Telegram* from the Secretary of the Consolidated Electric Storage Co.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.
Anonymous communications cannot be noticed.
The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.
In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.
Sketches and drawings for illustrations should be on separate pieces of paper.
All communications should be addressed EDITOR OF THE ELECTRICAL ENGINEER, 150 *Broadway, New York city.*

THE TANNING OF SHEEPSKIN.

[151.] We read with great interest your article on "Tanning by Electricity," in your issue Nov. 26th, and would put a few questions to you which probably can be solved by one of your correspondents. We are tanning sheep, lamb, goat and calfskins into kid leather with alum and salt. It requires only a few hours to tan the skins, so electricity wouldn't help us any as far as time is concerned, but sheep and lambskins contain a great deal of fat, which at present we extract after the skins are tanned, by putting them into naphtha over night. Now we would like to hear whether it wouldn't be possible to extract this grease with electricity during the tanning process. If any of your correspondents wish to try the experiment we shall be glad to furnish them with the skins, or if they want to try it at our factory we shall be glad to furnish them with anything they need. If this can be done without too heavy expense, the one who invents the system will be able to make a fortune. WINTER & GOETZ.

READING, PA., Dec. 9, 1890.

EUROPEAN CORRESPONDENCE.

LONDON.

Dinner of Electrical Engineers.—Central London Railway.—Overhead Wires Bill.—Lineff System.—Northfleet Electric Trains.—Montevidean Telegraph Company.—Expiring of Telephone Patents.

LAST Thursday evening the second annual dinner of the Institution of Electrical Engineers was held at the Criterion Restaurant. Dr. Hopkinson, the president, occupied the chair. There was a goodly muster of men connected in various ways with electricity, who sat down to a repast well served up by Spiers and Ponds. Among those present were: Mr. Raikes, the Postmaster-General, Sir Richard Webster, the Attorney-General, and Dr. Coleman Sellers, of America. On the whole it was not considered a lively evening. Speeches were in the main dull and tedious, the wit being entirely in the hands of the Attorney-General and the Toastmaster. Mr. Raikes, in returning thanks for Her Majesty's Ministers, said that the department over which he presided had closer relations with electricity than any other department of the State. It was an interesting fact that during the nineteen years of Governmental administration of the Post Office the number of telegrams had grown from 10,000,000 in 1871 to 62,500,000 in 1889. He recalled with pride that the Post Office had given no less than three presidents to the Institution, Mr. Scudamore, Mr. Preece and Mr. Graves. It was not in this department alone, however, that electricity entered into the service of the Government. The Board of Trade had special and important relations in the working of the Electric Lighting Acts. Many who were there that night thought electric lighting had been unduly arrested by the jealousy of Parliament. He understood the feeling, but did not share it. When a new science appeared it was desirable that time should be given for it to develop. The authorities had been wise in holding their hands for some years before taking any decisive steps in licensing and extending the use of electric light. The speaker then went into the subject of electricity in the Navy.

Sir George Stokes responding on behalf of the "Learned Societies" referred to his probable successor as president of the Royal Society, who without much doubt would be Sir William Thomson. Mr. Raikes in proposing the Institution mentioned that the number of members in 1872 was 268, at the present time it was 1,738, an increase of 1,470. There were two students in 1872, now they had over 102.

I hear that it is probable that the Central London Railway will apply again to Parliament for the necessary powers to erect an underground railway worked by electricity. It will extend from Bayswater to the city, along the line of Holborn and Oxford street. Last session the bill was thrown out in the House of Lords on the ground that there was no successful operation of a like nature to point to. If then, the South London Railway proves ultimately to work well, there appears to be no valid reason for preventing a similar undertaking in another part of London.

The London County Council propose to bring in an Act to Parliament which will enable them to control the whole of the overhead wires in London.

The Lineff system (closed conduits) of electric traction will now have opportunities of proving its practicability on a length of line of 8½ miles. The Hammersmith Vestry last week granted full permission.

As the object for which conduit cars were run on the Northfleet road has been accomplished, the electric trams have ceased to run, and we may expect shortly the report of the working during the past eighteen months.

The Montevidean Telegraph Company at an extraordinary meeting held yesterday, passed resolutions to wind up the concern and to transfer the whole business to the Western and Brazilian Company, under an arrangement favorable to the shareholders.

As the time draws near for the expiring of the telephone patents owned by the National Telephone Company, the struggle becomes very keen where other companies work by license a telephone business. For the past eleven years a highly successful telephone exchange, conducted by a local company, has been in existence in Sheffield, and during the latter portion of that period the National Company has also had an exchange in the same town. As the expiration of the telephone patents approaches, the competition between these companies grows keener, and the rates now charged in Sheffield will probably become general throughout the country. The town company recently announced a reduction of rates to £7 per annum, and this was at once followed by a reduction on the part of the National Company to £5 per annum. In view of the arrangements that are being made to challenge the monopoly of the National in all large centres by properly constituted companies, it remains to be seen how soon this company will realize the nature of the coming struggle, and how soon it will meet the same by a general reduction of rates to the level arrived at in Sheffield. Meanwhile the Sheffield Company is preparing to join hands with the new companies for mutual support, and if inter-town communication is to be a real necessity of future telephonic developments it may reasonably be anticipated that through wires for the same will be readily provided by the Postmaster-General and probably on terms less burdensome than those of the National Telephone Company. H. S.

LONDON, Nov. 26, 1890.

CORRESPONDENCE.

CHICAGO.

Extending the City Circuits.—The Bear Magneto Electric Co. Formed.—An Electric Car Train-Struck.—Adoption of Electric Welding-Calumet Electric Railway.

ELECTRIC lights have now been placed on Lake street from Ashland avenue to Western avenue. They are operated from the city power house at Troop and Van Buren streets, which is intended to supply the whole of the West Side. It is not decided whether any more lights will be put in this winter, but eventually the street will be lighted all the way down town.

The Bear Magneto Electric Co. has been incorporated, with a capital stock of $3,000,000, to do a general light, heat and power business. The double armature dynamo which the company proposes to use is the invention of Mr. J. M. Bear, one of the incorporators. The machine is to be made portable so that it can be set up wherever light is required. The incorporators of the new company are S. J. M. Bear, William R. Northway and Franklin Babcock.

An electric street car at a railroad crossing in Wichita, Kan., was struck by a train running twenty miles an hour, knocked forty feet and almost completely demolished. The motor man jumped and escaped with slight injuries. There were only two passengers in the car at the time of the accident. They are thought to be fatally injured.

The manufacturing firm of Craver, Steele & Austin, located at Harvey, Ill., are about to introduce the process of electric welding into their works at that place. With this process, as is now well known, with suitable apparatus, it is possible not only to weld iron and steel, but also metal which heretofore could not be successfully united. Pieces of such metals and alloys as wrought iron, copper, silver, brass, lead, tin, aluminum and even cast iron, can be not only melted to each other, but the different metals can be welded together. The tensile strength of the weld as demonstrated by mechanical tests, has proved to be highly satisfactory.

Two Calumet electric street railway ordinances were presented by Alderman Gorman, at the council meeting last week, one being the complement of the other. The routes indicated are 1. Beginning at the intersection of Seventy-ninth street and Cottage Grove avenue, thence south on Cottage Grove avenue to 87th street, also commencing at the intersection of 93d street and Cottage Grove avenue to 95th street.

2. Beginning at the intersection of Cottage Grove avenue and 93d street, thence west on 93d street, extended to South Park avenue, extended thence south on South Park avenue, extended to 95th street, thence west on 95th street to Stewart avenue. The fare is to be five cents and the road is to be in operation within a year after the passage of the ordinance.

CHICAGO, Dec. 12th, 1890.

SOCIETY AND CLUB NOTES.

PROVIDENCE MEETING OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

The following notice has been issued by General C. H. Barney, chairman of the committee on exhibits:

In connection with the meeting of the National Electric Light Association in Providence, R. I., on February 17th, 18th and 19th, 1891, it is proposed to hold an exhibition of electrical apparatus and appliances, especially such as are used in the business of furnishing light and power. To this exhibition, all Associate members are earnestly requested to contribute.

A suitable hall has been secured opposite the hotel which will be the Association headquarters, and through the courtesy of the Narragansett Electric Lighting Co., all the electric current necessary will be provided. There will be run into the hall, three circuits, viz: 1st, an incandescent alternating current converted to 50 volts; 2nd, a 500 volt direct current from T.-H. generators; 3d, an arc current of $6\frac{8}{10}$ amperes.

There will be no charge for space or current to exhibitors, who must, however, be Associate members of the Association. The installation and care of exhibits will of course be at the expense of exhibitors.

As this meeting may be said to virtually mark the close of the first decade of electric lighting, commercially, it is suggested that as far as possible, efforts be made to show the progress in the art, by exhibiting the earlier forms of apparatus and appliances, together with those embodying the latest improvements.

The exhibition will open on Tuesday, February 17th, and close on Thursday evening, Feb. 19, and will be open day and evening. Exhibits may be installed on the Saturday and Monday previous, and removed on the following Friday.

It is expected that this exhibition will prove very attractive to the Providence public, as well as to the members of the Association. To exclude the street gamin element, a nominal admission fee (25cts.) will be charged, but it is intended to circulate complimentary invitations freely among the representative business men of the city, and exhibitors will be supplied with as many complimentary tickets as they may desire to distribute.

As space is limited and will be allotted in the order in which applications are received, it is desirable that all intending exhibitors apply to the Chairman of the Committee prior to January 15th 1891, at which date all allotments of space will be made.

BOSTON ELECTRIC CLUB.

The annual meeting of the Boston Electric Club was held at the club rooms this week, writes our New England representative, President Cram presiding, at which there was a good attendance. The following officers were unanimously elected: President, Capt. Eugene Griffin; vice-presidents, C. J. H. Woodbury and C. L. Edgar; treasurer, F. J. Boynton; secretary, R. F. Ross; historian, G. W. Mansfield; directors, *for one year:* J. Edward Addicks; George E. Hanson; John C. Wilson; Wm. Brophy; Chas. B. Burleigh. *For two years:* A. L. Rohrer; Henry B. Cram; R. F. Ross; L. S. Dumoulin; George B. Neal. *For three years:* F. J. Boynton; Frank H. Monks; George W. Adams; Wm. C. Woodward; W. J. Denver. *For four years:* Frank Ridlon; E. H. Hewins; J. R. Lovejoy; W. D. Warner; C. W. Holtzer.

At the close of the meeting Captain Brophy, in a few well-chosen remarks, presented, in the name of the club, to President Cram an excellent picture of himself. Mr. Cram in thanking the members, took occasion to say that he was of opinion that the club was now in a more successful condition than ever, and that he looked forward to the coming winter with every degree of hopefulness for its continued prosperity. A few happy speeches were made by a number of the members, and the house and entertainment committee stated that they had a number of entertaiments and lectures in preparation.

PROF. CROCKER TO LECTURE BEFORE THE NEW YORK ELECTRIC CLUB.

The regular monthly meeting of The Electric Club will be held Thursday evening, December 18. Prof. Francis B. Crocker, of Columbia College, will lecture on "Electrical Units of the Present and Future." Prof. Crocker will review the derivation of, and relations between, the present electrical units, and discuss the creation of other electrical units which now are, or soon will be, required in electrical science and industry. It is proposed to treat this subject, as far as possible, in a non-mathematical manner, and give the most important facts regarding electrical units in popular yet comprehensive language.

A brief business meeting of the club will be held at 8 o'clock to discuss proposed amendments to the by-laws. The lecture will begin promptly at 8:30. This is the last meeting of the present year, and every member should attend. The club's regular dinner (costing $1) will be served from 6 to 8 p.m. Members who expect to dine at the club should notify the clerk at the Club House.

REPORTS OF COMPANIES.

COMMERCIAL CABLE CO.

Two men who have a right to be happy just now, says the *Morning Journal* of Dec. 7, are John W. Mackay and Manager George G. Ward, of the Commercial Cable Company. Amid all the Wall street stringency the company's shares held firm as a rock, and with good reason. Its latest declared dividend of 1¾ per cent. shows that it has become a 7 per cent. stock—a triumph for pluck, good service and good management.

EDISON ELECTRIC ILLUMINATING COMPANY OF NEW YORK.

The Board of Directors of the Edison Electric Illuminating Company of New York have declared a quarterly dividend of 1 per cent., payable January 15, 1891. In addition, the directors have declared a dividend of 5 per cent. on its capital stock, representing surplus earnings, payable in certificates convertible into stock at par whenever the company shall increase its capital stock beyond the present authorized amount, or redeemable in cash, at par, at the option of the company. Until so converted or redeemed these certificates will bear interest at the same rate, and payable at the same time, and in the same manner, as dividends may be paid on the company's capital hereafter. These dividends will accrue to stockholders of record January 2. Convertible certificates will be delivered on and after February 2. Transfer books reopen January 21.

WESTERN UNION TELEGRAPH COMPANY.

The Board of Directors have declared a quarterly dividend of one and one-quarter per cent. upon the capital stock from the net earnings of the three months ending December 31st instant, payable at the office of the Treasurer on and after the 15th day of January next to stockholders of record at the close of the transfer books on the 20th day of December inst.

THE AFFAIRS OF THE WESTINGHOUSE CO.

A special dispatch from Pittsburgh of Dec. 10 says: "The committee of local bankers recently appointed to investigate the financial standing of the Westinghouse Electric Company finished its labors to-day. Its report is understood to be favorable. The committee determined that the electric company stocks are worth over $25 per share, and decided to advance the $500,000 recently requested by Mr. Westinghouse, on condition that the parties making the loan have the privilege of naming the general manager for the company. The full Board of Managers of the Westinghouse Electric Company, at its meeting this morning, resolved to request the stockholders, at their meeting this afternoon, to issue $3,000,000 of preferred stock." This is to be done.

DIVIDENDS.

THE EASTERN ELECTRIC CABLE CO. has declared its regular semi-annual dividend of 3 per cent. on its preferred stock, payable Dec. 16, 1890.

DULUTH, MINN.—The Duluth *Tribune* of Dec. 2 says: "The Hartman Electric Company, of which Alexander W. Hartman is president, held its regular annual meeting yesterday. The principal business consisted in the pleasant duty of distributing $8,000 among its shareholders. This amount constitutes the semi-annual dividend, and would appear to indicate a very successful company."

STOCKS AND BONDS.

QUEBEC, CAN.—A premium of 15 per cent. has been offered for some new shares of stock in the Quebec & Levis Electric Light Co., lately placed on the local market.

HUNTINGTON, IND.—The electric light and artificial gas plant, owned by Deck and Parker, has been sold to J. B. Townsend, of Lima, O., representing the "Brice syndicate."

SHEBOYGAN, WIS.—The German Bank has assumed control of the Sheboygan Electric Light Company's plant, and has also taken up the mortgage of $25,000 given by President Clarke for the money of which he claims to have been robbed in Milwaukee some days ago.

ALPENA, MICH.—The capital stock of the Alpena Electric Light Company has been increased to $84,000. The increase was on account of the large extension that is to be made to the works. Among the improvements will be an incandescent light system.

BRIDGEPORT, CONN.—The earnings of the Bridgeport Horse Railroad Co. were $84,000 last year; with the road and its extensions equipped electrically, it is calculated by Mr. J. N. Beckley that the earnings will be $200,000 the first year.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED DEC. 9, 1890.

Alarms and Signals :—

Electrical Signal for Engines, M. Conley, 442,104. Filed Oct. 3, 1889.

Electric signal from the engine to the pilot or captain of a steamer, to indicate in which direction the shaft is revolving. Electrical contact-points are mounted upon the engine and made and broken directly by a movable part of the engine.

Non-Interference Fire-Alarm Signal-Box, P. V. Merrifield, 442,383. Filed March 7, 1890.

The non-interference mechanism in all the boxes in a circuit operate simultaneously so that "breaking in" is impossible until the alarm rung by the first pull is completed.

Electric Leak or Flow Detector, G. S. Neu, 442,385. Filed March 20, 1890.

First claim follows :

The combination, with a fluid-conduit having a valve-port, of a flow-detecting valve working perpendicularly to said port and provided with a stem also guided perpendicularly to said port, a circuit-closer, and a circuit-closer-operating rod coupled to the valve stem and working in alignment therewith, substantially as described.

Electric Bell, C. B. Beers and W. B. Tuttle, 442,473. Filed Nov. 16, 1889.

A bell and a "buzzer" combined in a single apparatus for producing two separate and distinct signals.

Conductors, Conduits and Insulators :—

Underground Electric Conduit, H. H. Young, 442,162. Filed June 23, 1890.

Consists of an outer conduit in jointed sections, an inner conduit of similar structure breaking joints with the outer conduit, packing interposed between two suspending plates within the inner conduit for the conductors, insulating material surrounding each, and a compound surrounding all the conductors; lids upon the sections of the conduits grooved to receive the upper edges of the body of the conduit. The body of the conduit is U-shaped.

Electric Connector, W. H. Garland, 442,370. Filed Sept. 19, 1890.

A device for connecting a small conductor to a larger conductor, as for example, a connecting wire to a railway track.

Consists of a cylindrical pin or plug with a straight, longitudinal groove on one side, of sufficient size to permit the connector to be placed upon the wire which it is desired to insert in the larger conductor, the edges of the groove being so arranged as to be compressed over the connecting wire when the connector is driven into a hole bored for the purpose in the rail or other larger conductor.

Conductor for House Lighting, W. H. Eckert and W. H. Gregory, 442,575. Filed Sept. 15, 1890.

The conductor is made in sections, each section consisting of an insulating tube having end plugs, a centrally arranged wire much smaller than the bore of the tube arranged therein, metallic heads in the end plugs to which the central wire is connected, the plugs being provided with screws for joining or separating the sections.

Dynamos and Motors :—

Electric Motor or Dynamo-Electric Machine, C. E. Dressler, 442,178. Filed April 14, 1890.

First claim follows :

In an electric motor or dynamo machine, a field magnet within the same composed of cylindrical sectors of like polarity connected to sectors of opposite polarity by cores wound with exciting coils of insulated wire within a zone separating said sectors, substantially as and for the purposes set forth.

Speed Regulator for Electric Motors, W. W. Schiffmann, 442,208. Filed April 28, 1890.

A series of graduated contact plates are embedded in the hand piece of a dental engine, and are electrically connected with a rheostat, for the manual regulation of the motor while the dental engine is in use.

Electric Motor and Frame, A. Schmid, 442,459. Filed Aug. 1, 1890.

Design and construction intended to cheapen manufacture and to secure greater durability and more convenience in handling and repairing, also to reduce the number of parts. Applicable particularly to motors for railway work.

Galvanic and Thermo-Electric Batteries :—

Carbon Electrode and Method of Making the Same, I. L. Roberts, 442,336. Filed Feb. 14, 1890.

First claim follows :

The method or process of manufacturing carbon electrodes, which consists in mixing together powdered carbon and an insulating binding material, such as paraffine or its equivalent, heating the mixture to fuse the insulating material, then subjecting the mixture to pressure in a mold to express the excess of insulating material, and then cooling it.

Galvanic Battery, C. E. Dutton, Jr., 442,516. Filed Sept. 6, 1890.

Design and construction of cell and elements with a view to securing the fixity of the parts in position and to secure portability without detriment to the cells.

Electrolysis :—

Separating-Diaphragm for Electrolytic Cells, I. L. Roberts, 442,203. Filed March 14, 1889.

The inventor discriminates between the "purely electrical resistance," and the "electrolytic resistance" of a separating diaphragm.

Claims 1 and 6 follow :

1. In an electrolytic cell, the combination, with the electrodes of an intermediate partition or diaphragm having a relatively high electrolytic resistance, as set forth.

6. A composite diaphragm or partition for electrolytic cells, composed of a gelatinous or equivalent substance, held by rigid or equivalent supports in the form of a dividing wall or partition between the electrodes, as set forth.

Diaphragm for Electrolytic Cells, I. L. Roberts, 442,204. Filed March 14, 1889.

Employs asbestos freed from soluble constituents as material for diaphragms.

Electrolytic Apparatus, I. L. Roberts, 442,332. Filed July 13, 1888.

Inventor employs in an electrolytic cell, a non-porous diaphragm or partition, composed in whole or in part of a body capable of acting as an electrolyte.

Apparatus for use in Electrolysis, I. L. Roberts, 442,333. Filed July 27, 1888.

Amplification of 442,332, covering the employment of two or more electrolytic partitions or diaphragms.

Electrolytic Apparatus, I. L. Roberts, 442,334. Filed Aug. 11, 1890.

In an electrolytic cell the inventor packs or embeds the anode in a material such as anthracite coal in the condition of an impalpable powder; uses an iron vessel or receiver as a cathode.

Claim 8 follows :

The combination, in a closed tank or vat, of an anode surrounded by a substance such as coal-dust, a gas-chamber or space above the same filled with granulated carbon, and a pipe leading therefrom for conveying off the gas, as set forth.

Electrolytic Apparatus, I. L. Roberts, 442,396. Filed March 14, 1889.

First claim follows :

An electrolytic apparatus consisting of a tank or vat divided with an electrolytic diaphragm or partition into two compartments containing conductors or electrodes, one of said compartments being adapted to contain the solution to be decomposed and the other or anode compartment filled with a finely-divided conducting substance, such as powdered coke or its equivalent, substantially as described.

Electrolytic Apparatus, I. L. Roberts, 442,594. Filed Oct. 22, 1890.

Claim 1 follows :

In a sealed tank or vat for electrolytic decomposition, the combination, with the anode embedded in or surrounded by a substantially non-porous electrolytic body, of an impervious cylinder around the anode, extending below the level of the solution, a layer of granulated carbon between the anode and the impervious cylinder above the level of the solution, and an outlet-pipe extending from the same.

Lamps and Appurtenances :—

Hanging Device for Electric Arc-Lamps, J. A. Lounsbury, 442,127. Filed July 23, 1890.

The lamp carries lamp-contacts of annular form ; the circuit contacts of the hanger comprise arms having bifurcated ends adapted to embrace the lamp-suspending medium and to engage the lamp contacts carried thereby. By the action of lowering, the line circuit is cut out of the lamp and automatically closed outside of it. The raising of the lamp to its normal position automatically re-establishes the circuit through it.

Device for Attaching Incandescent Electric Lamps to Gas Fixtures, N. Marshall, 442,270. Filed June 11, 1890.

A bracket for attaching incandescent electric lamps to gas fixtures, constructed from a single sheet of metal.

Incandescent-Lamp-Socket, G. W. Hunt and A. E. Rich, 442,287. Filed Oct. 29, 1890.

First claim follows :

The combination, with an incandescent lamp having a screw-threaded socket in its base and a flat eccentric contact-ring, of a socket having a threaded pin adapted to engage said threaded socket, and a sinuous concentric contact-ring, for the purpose set forth.

Pulley Attachment for Electric Lamps, T. H. Brady, 442,415. Filed July 14, 1890.

Consists of a pulley cover having a socket groove formed at its upper part, the cap-plate having the socket groove, and a shutting over flange on one of said parts to cover the seam at the socket groove.

Ceiling Block, H. T. Paiste, 442,451. Filed Oct. 14, 1889.

A design and construction of cut-out for pendant lamps.

Ceiling-Block, H. T. Paiste. 442,452. Filed Feb. 26, 1890.

First claim follows :

The combination in a pendant cut-out, of the base and terminals thereon, with a cut-out-carrying disc having terminals in line with the terminals on the base, with a cap resting upon the terminals of the disc, whereby on the securing of the cap to the base the terminals of the disc and plate are united, substantially as described.

Holder for Electric Lamps and Hoods, G. L. Batchelder, 442,472. Filed May 5, 1890.

A combined hood and lamp holder.

Claim 2 follows :

In a hood and lamp holder, the combination, with a hook on the support and a sliding bar on the hood provided with a hook having laterally-extending lugs, of a spring-guide extending over the hook provided with a central opening and inwardly-extending beveled portions, substantially as described.

Shade and Reflector for Electric or Other Lights, W. S. Fraser, 442,577. Filed Apr. 16, 1890.

An adjustable shade or reflector, capable of expansion or contraction, as desired.

Electric-Arc Lamp, W. B. Henderson, 442,580. Filed Aug. 4, 1890.

Object, to provide for the successive operation of four or five sets of carbons. Invention consists, in general terms, in providing two rotating hubs, each having a series of three or more radially-arranged carbon-holders, with mechanism for rotating the hubs and bringing the carbon-holders into proper relation to each other successively.

Electric-Switch, N. Marshall, 442,588. Filed June 11, 1890.

A revolving snap-switch for incandescent lamps.

Measurement :—

Method of and Apparatus for Measuring Electric Currents, S. C. C. Currie, 442,423. Filed Dec. 26, 1889.

Consists in actuating the indicator device by a resultant force due to two forces—one acting to repel and the other to attract—the ratios of the two forces being so related that as one diminishes the diminution is compensated by an increase in the other whereby a direct reading is obtained. The device is electro-magnetic, a movable armature being operated upon by the two forces.

Electric Meter, J. J. Wood, 442,501. Filed Nov. 3, 1888.

Current to be measured passes intermittently through a thermo-expansible strip or wire, being switched around it when the strip attains a certain expansion and again directed through it when it has contracted to a given length by cooling; the successive heatings being counted by suitable devices.

Claim 1 follows :—

In an electric meter, the combination of an elongated solid body arranged to be expanded by the heat generated by an electric current in encountering a resistance, a compensating expansible elongated body exposed to the same variations of surrounding temperature, a lever to which both said bodies are independently connected at different points, whereby the lever is moved by the elongating and shortening of both said bodies and its angular movement corresponds to their differential elongation or contraction, so that the compensating body corrects the disturbing effect of changes in surrounding temperature, and a switch for directing the current intermittently through said resistance, connected to said lever to be operated by the angular movements thereof.

Miscellaneous :—

Electric Gate, H. Gillette, 442,114. Filed July 19, 1890.

Gate operated by an electric motor and controlled through a circuit-closer operated by an electro-magnet.

Tanning by Electricity, L. A. Groth, 442,115. Filed May 19, 1888.

Consists in placing the hides and tanning liquid in a stationary tank, passing a current of electricity through the liquid and the hides, and moving the hides during the passage of the current, in planes transverse to and alternately toward and from a positive and negative electrode.

Electrical Vote Recorder, S. D. Locke, 442,126. Filed May 7, 1889.

Invention consists mainly in the peculiar arrangement of the manipulating apparatus with a view to securing them under lock and key from being tampered with during the absence of a member of a legislative or other assembly while a vote is being taken.

Insulating Covering for Pincher Handles, G. F. Virtue, 442,155. Filed July 31, 1890.

A rubber tube, shaped with a taper to adapt it to the ordinary form of handle, and relatively thin on one side, is slipped upon the handles of pinchers or pliers.

Cash Register, L. Ehrlich, 442,249. Filed March 21, 1890.

Indicating or registering mechanism actuated through electro-magnetic devices.

Mechanism for Controlling Torpedoes, &c., G. R. Murphy, 442,327. Filed Dec. 17, 1889.

Claim 2 follows :—

In torpedoes and other similar submarine vessels, the means for automatically releasing, under the application of a predetermined tension, the cable stored or coiled therein, and likewise for releasing the same through the agency of the electric motor controlling the valve admitting the fluid power to the engine, consisting of the cable provided with a bulb, a tube for the same, a resisting catch in the tube, a motor, and a connection between said catch and motor whereby the latter may release the former, substantially as and for the purpose set forth.

Metal Working :—

Process of Making Metal Tubes, etc., by Electro-Deposition, F. E. Elmore, 442,428. Filed Jan. 17, 1889.

Consists in revolving the cathode in an electrolytic bath while the current is passing, and simultaneously compacting the deposited metal by the action of a burnisher gradually moving from one portion to another.

Railways and Appliances :—

Circuit for Electric Railways, E. W. Sabolder, 442,140. Filed Sept. 22, 1890.

Consists of a series of electrical conductors, as say, plates or bars or rods, fixed in the ground in proximity to the track rails and in electrical contact with the latter, being practically an amplification of the earth contact.

Attachment for Span-Wires for Suspended Electric Conductors, F. Mansfield, 442,282. Filed April 26, 1890.

A device for raising and lowering span-wires. A polygonal-shaped block is mounted upon the outer face of each pole and adapted to be moved up and down the pole by rotation of the block, the span-wires being connected to the axis of the block so as to be vertically adjusted by their movements.

Charging Apparatus for Switch and Signal Mechanisms, J. G. Schreuder, 442,339. Filed July 16, 1890.

Electro-magnetic devices employed to control the operation of valves in a system of switching or signaling through the means of fluid-pressure.

Railway Car Telegraph, C. R. Arnold, 442,347. Filed July 13, 1889.

Apparatus and devices for signaling to the engineer from any car of a train, and for answering and repeating from the locomotive. Provides for a continuous signal to be given by a vibrating bell on the locomotive in case a train should part at any point. Includes arrangements for supplying the train circuit from a dynamo carried on the engine. Makes use of air or steam pipes as conductors for the circuit in part.

Electric Traction-Increasing System, M. W. Dewey, 442,365. Filed July 28, 1890.

Consists in a stationary source of heavy current or currents connected to the rails of the track and two or more wheels of the vehicle, and one or more axles or other low-resistance conductor extending between the wheels to complete the circuit through the rails.

Electric Railway, M. J. Wightman, 442,407. Filed April 1, 1885.

Object is to economize in the weight of conductors and to secure independence of action in the motors on different lines or sections of lines of rails. The invention is essentially an improvement or amplification of the three-wire method of distribution. The system of connections constitutes in effect a series multiple-arc system, in which the compensating action of the well-known three-wire system obtains. It is in substance a 4-wire system, or a 3-wire system extended to contain a third set of apparatus supplied in multiple to one another, but in series with the two other sets or sections.

Trolley-Wire Hanger, H. H. Luscomb, 442,446. Filed Sep. 19, 1890.

A design and construction for a hanger adapted to grasp firmly and securely a trolley-wire without employing solder.

Slot-Switch for Conduit Systems of Railways, F. O. Blackwell, 442,475. Filed Oct. 27, 1890.

Claim 1 follows :

In a conduit-switch, the combination of a movable slot-switch with a swinging hanger or hangers furnishing means of support therefor, for the purpose set forth.

Secondary Batteries :—

Method of and Apparatus for Manufacturing Secondary-Battery Electrodes, J. G. Johnston, 442,187. Filed Aug. 15, 1890.

Relates to the class of electrodes in which the active material is contained in an external envelope or supporting case.

First claim follows :—

The process of forming secondary-battery plates having a perforated metallic envelope or supporting case, which consists in separately striking up and perforating the metallic sides of the plate, and then assembling said sides and the active material in a dry state upon the punching-die, and finally compressing the whole together in said die, as and for the purpose intended, substantially as described.

Secondary Battery, J. K. Pumpelly, 442,390. Filed Feb. 10, 1890.

Consists essentially in arranging the positive and negative plates edge to edge rather than face to face. Shows the negative electrode in the form of a rectangular frame, and the positive electrode as a rectangular plate of suitable size to be suspended or held within the opening of the negative electrode and in the same plane with it.

Seconday Battery, J. K. Pumpelly, 442,391. Filed March 24, 1890.

The electrodes are separated and held apart by cellulose and wood-pulp fiber.

Telegraphs :—

Telegraphy, E. B. Ives, 442,267. Filed Feb. 24, 1890.

Applicable to synchronous multiplex systems, and consisting chiefly in devices for duplex working.

Relay, J. G. Schreuder, 442,338. Filed July 16, 1890.

The claim follows :

In a relay, the combination of electro-magnets and a gravity-armature formed of resilient material, the pivotal support and contact-point of the armature being arranged in a plane below the poles of the magnets, whereby the armature is placed under tension when attracted by the magnets, substantially as set forth.

Printing-Telegraph, W. W. Taylor, 442,497. Filed May 26, 1890.

First claim follows :—

A printing-telegraph consisting, essentially, of type-writers electrically connected and having means for operating the type-levers thereof, a paper-supply roll mounted in the type-writer carriages and having means for feeding the paper through the type-writers, a box mounted on the type-writer carriages and having a suitable opening therein, a vertically-movable two-edged knife adapted to cut off the paper at a desired time and place, means for moving said knife, and a guide fixed to the back of the knife and adapted to align with the opening in the box, substantially as described.

Telephones and Apparatus :—

Multiple Telegraph or Telephone, A. M. Rosebrugh, 442,139. Filed June 6, 1887.

Object is to increase the working capacity of a telephone circuit, to facilitate long distance telephony and to provide for duplex working.

First claim follows :—

The combination, in a system of telephonic communication, of a metallic or double parallel line circuit extending between two or more stations, local circuits including telephone apparatus connected by means of induction coils with both sides of the said double line main circuit, and earth branches including telephones connected with the said metallic circuits at the terminal stations thereof and at a point between the said induction coils, whereby the stations inductively connected with the double-line circuit may be enabled to communicate with one another, to the exclusion of the earth branch stations, and vice-versa, as hereinbefore described.

Multiple Switch-Board System, C. E. Scribner, 442,143. Filed Oct. 15, 1888.

A feature of the invention lies in the discovery that the introduction of a retardation coil into a ground branch extended from one side of a metallic

circuit overcomes the harmful effect of such grounding by shutting off the flow of induced currents, which would otherwise disturb the telephone.

Tenth claim follows :—

The combination, with two metallic telephone line circuits looped together at one of several multiple switch-boards with which said lines are connected, of a branch circuit from the side of the united circuit, said lines connected with the test-pieces of the switches, said branch, including a self-induction coil and battery, and a corresponding branch circuit to ground from the other side of said metallic circuit through a corresponding self-induction device, whereby the said circuit is balanced with respect to inductive effects, substantially as and for the purpose specified.

Telephone Exchange Apparatus, C. E. Scribner, 442,144. Filed Nov. 23, 1888.

For use with metallic circuit. Provides for uniting any two circuits without including in the united circuit any electro-magnetic devices other than the telephones of the subscribers thus connected, while at the same time providing for signals between the central office and subscribers for connections and disconnections.

Multiple-Switch-Board System, C. E. Scribner, 442,145. Filed Nov. 23, 1888.

Relates to the class of multiple switch-board circuits in which metallic circuits and single or grounded circuits are connected with the same exchange. The invention is designed to avoid the necessity of employing special test-plugs at the central station in adapting to the service of mixed metallic and grounded circuits, the methods of patent number 412,143 above.

Telephone Exchange Apparatus, C. E. Scribner, 142,146. Filed Dec. 10, 1888

Object is to loop the different lines together without including any unnecessary resistance in the talking circuit.

First claim follows :—

The combination, with two subscribers' stations, of their metallic-circuit telephone-lines looped together to form a single metallic circuit for conversation free of resistance, except the telephones, the different sides of said metallic circuit being provided with a branch circuit, each such branch circuit containing the individual annunciator of its line, each annunciator constructed to operate as a self-induction coil, and each of said branch circuits being connected to a ground branch, including a battery.

Telephone Toll-Station, J. W. Vaughn, 442,342. Filed April 24, 1890.

Apparatus for indicating automatically to a central station operator the fact of the deposit and the denomination of a coin placed in the slot at a toll station.

LEGAL NOTES.

LEROY B. FIRMAN AND THE WESTERN ELECTRIC CO. vs. THE NEW HAVEN CLOCK CO.—DECISION IN FAVOR OF DEFENDANT ON THE MULTIPLE CALL BOX PATENT.

This was a bill in equity to prevent the alleged infringement of the fifth claim of letters patent, No. 192,644, dated July 3rd, 1877, granted to Leroy B. Firman, and owned by the Western Electric Co., for improvements on automatic signaling apparatus, used in the system known as the "district telegraph system," in which "each station is designated by a number, and the apparatus is constructed to write that number as a 'call' and subsequently to write any one of several signals, at the will of the operator."

The apparatus was an improvement upon the device described in letters patent No. 185,455 to G. S. Ladd and S. D. Field, which contained one circuit breaking wheel.

The improvement consisted in two wheels, instead of one, which automatically and successively communicated to the central office the two sets of signals.

The fifth claim, and the one which is said to have been infringed, is as follows :

"5. The combination, with a call writing wheel, of a signal writing wheel, moved by the same power, when the latter is provided with a number of equal-spaced teeth, which write the signal desired by making a certain number of equal-spaced impulses, substantially as specified."

The defendant uses an apparatus which is described in letters patent No. 321,073, dated June 30th, 1885, to Frank B. Wood. It produces a compound signal by the joint action of two wheels. It has "two signal wheels which are geared to each other and to the clock work, so that they both move simultaneously and in unison during the time that both parts of the compound signal are being transmitted ; while thus in motion, they are acted upon by opposite ends of the same electrical contact spring."

The plaintiffs claimed that the equivalent of the Firman signal wheel was the small wheel of the defendant, which transmits by a series of equally-spaced impulses, and that the equivalent of the call wheel is the large wheel of the defendant, which has its periphery so cut away as to determine the numerical signal which is sent, notwithstanding that the actual transmission of the signal is performed by the other wheel, and that thus the defendant's device contains the call wheel and the signal wheel of the fifth claim.

Judge Shipman, in his decision, says : "If a literal construction is to be given to the fifth claim, and the requisites of infringement are a signal writing wheel, with equally-spaced teeth, which makes equally-spaced impulses, and a call writing wheel in combination, regardless of the manner in which these two wheels operate to produce the result, the remaining element being power operating the two wheels in such a manner as to transmit the compound signal at one operation, then the defendant infringes.

"In my opinion, such a broad construction cannot be given, but the scope of the patent must be confined to mechanism substantially such as is described in the patent, viz., two wheels, moving by the same power, in succession and automatically, one of which produces a part of the signal by its sole action, and the other of which produces the other part by its sole action. It is true that the Firman invention was the first one having two wheels which did both parts of the work automatically, but this step cannot give the device the character of a primary invention and permit the inventor to include within his patent wheels which differ so wide from his apparatus as do the double wheels of the Wood patent.

"The bill is dismissed."

George P. Barton and Wm. Edgar Simonds, for the plaintiffs.
Harry M. Turk and Arthur v. Briesen, for the defendant.

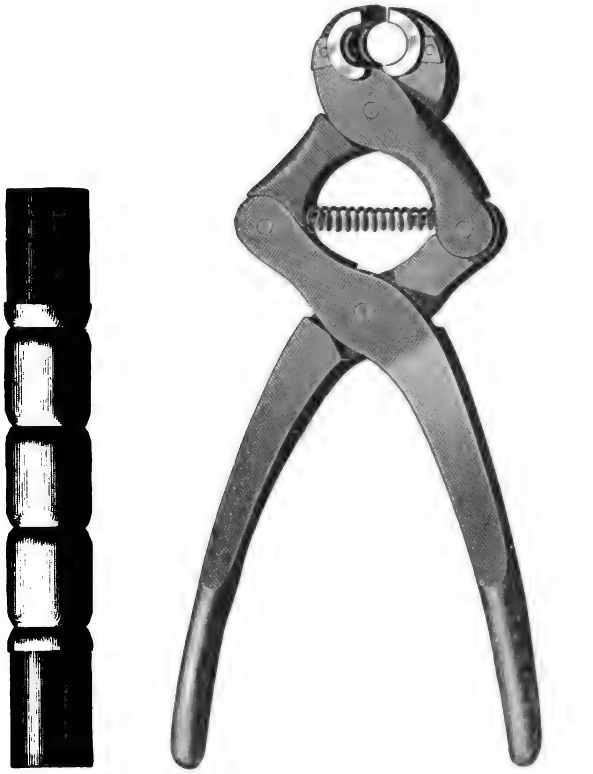
TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

NEW DETAILS OF THE INTERIOR CONDUIT SYSTEM.

The superiority of the Interior Conduit system, not only for all classes of electr c light wiring but for electric bell and annunciator wiring a s well, has been demonstrated and is now universally conceded.

The Interior Conduit & Insulation Company, the pioneers and sole manufacturers of interior conduits, are continually striving to simplify the constructionary methods of their admirable system and to cheapen the cost of their goods. One of the most striking examples of their energy in this direction is to be found in their new coupling or joint which we illustrate in the accompanying engraving, Fig. 1.



FIGS. 1 AND 2.—NEW "INTERIOR CONDUIT" JOINT AND JOINTING TOOL.

The greatest amount of labor expended in the installation of the system is at the most vital point of the whole, that is, upon the joint or coupling.

The methods heretofore employed for making joints have been found satisfactory, but in order to insure perfect work great care had to be exercised on the part of the workmen, and it is with the idea of remedying this that the new coupling has been designed and placed upon the market.

The new joint will supplant and entirely dispense with the use of the threading tool, threaded coupling and cementing compound. The sleeve is made of soft galvanized iron and, being of a slightly larger diameter than the tube itself, fits snugly upon it. The tool, Fig. 2, which is made in the form of a pair of pliers, serves to

press the two slight corrugations upon the outside of both halves of the sleeve and into the body of tube, but does not in the least injure the latter or alter its internal diameter at that point. Joints so made are impervious to moisture and have great strength.

By the new method, joints may be made upon the floor or bench and the lengths of the tubing lifted with safety to the wall or ceiling without fear of straining or opening the joints. It is confidently believed that the new tool is destined to become an important factor of every wireman's kit of tools.

MR. HENRY HUTTON.

Mr. Henry Hutton, of Baltimore, and formerly connected with the Western Electric Co., of Chicago, intends resuming his old line of business as a consulting electrical engineer, and he will establish himself at Tacoma, Wash., within the next ten days. Mr. Hutton will be glad to receive at that place catalogues of light and power supplies, and to represent reliable houses.

ELECTRICAL SUPPLY CO., CHICAGO.

The above house has just issued a catalogue of Edison specialties and a circular of Edison incandescent lamps. The specialties include meters, switches, holders, insulating joints, sockets, plugs, cut-outs, &c. The company is now making a feature of handling these Edison goods.

MR. W. J. HAMMER.

A man highly original in his ideas and methods, Mr. W. J. Hammer, who has recently established himself in the Temple Court annex, this city, has chosen a unique manner of preparing and issuing his professional circular as a consulting and supervising engineer. It is by all odds the most interesting thing of the kind that has ever fallen into our hands, and Mr. Hammer reaches his result without any sacrifice of dignity. For the past 12 years he has been actively engaged as an electrical engineer, and in many fields, particularly those of light and power, has been a pioneer. Associated with Mr. E. H. Johnson he started in London the first incandescent station in the world, and he has since had charge of large exhibitional plants in Europe and America. The pamphlet illustrates his career admirably. It is made up of testimonials of a very flattering nature from such men as T. A. Edison, E. H. Johnson, Elihu Thomson, F. J. Sprague, H. M. Byllesby, Wm. Wallace, F. S. Hastings and F. R. Upton, and interspersing there are a number of fine engravings, each of which has some special point of interest. Thus for example there are views of the Edison exhibit at Paris in 1889 ; the Cincinnati exposition of 1888 ; the Crystal Palace electrical exhibition, London, of 1882 ; and the electrical exhibition at Philadelphia in 1884. Another picture shows the beautiful Ponce de Leon Hotel at St. Augustine where a plant was set up driven by an artesian well. There is also some very interesting text and data, and the pamphlet is just the kind of thing that one preserves for its intrinsic value. Mr. Hammer includes also a photograph of his wonderful collection of incandescent lamps, and has sensibly given all the testimonials in fac simile. The pamphlet is elegantly printed. Mr. Hammer, in a brief introduction, announces his intention of doing only consultative and supervisory work.

MR. E. G. BERNARD.

One of the most active and successful of the younger electrical engineers is Mr. E. G. Bernard, who after a long period of service with the Sawyer-Man and Westinghouse Companies, has recently started out on his own account, with what is practically a new system of electric lighting. He has established his headquarters at Troy, and the factories are located at Amsterdam, N. Y., and Warren, O. His experience of 11 busy years, during which time he has put more plants in silk mills and knitting mills than any other man in America, has taught him the points to aim at in dynamo construction, so as to secure continuity, stability and economy in operation, and the machines he is now building and installing are models of their class. As to his plants, we can speak of their thoroughness and high finish from some six years' acquaintance with his work. Mr. Bernard, who, by the way, is a member of the American Institute of Electrical Engineers, has not only embodied his own ideas in the machines, but has had their proportions thoroughly worked out with expert help, and he is guaranteeing them, under bond if desired, to be the equal in material, workmanship and automatic operation of any in the market. Mr. Bernard is already supplementing his record of 300 installations of other systems by a large number of "E. G. B." plants, and during the last 40 days has sold the following: Howgate, McCleary & Co., Amsterdam, N. Y., 300 lights; Packard Electric Co., Warren, O., 200; Utica, N. Y., Pipe Foundry Co., 100 incandescents and 4 arcs; Petit Bijou Piano Co., St. Johnsville, N. Y., 100; Roth & Englehardt, St Johnsville, 300; Standard Furniture Co., Herkimer, N. Y , 150; H. M. Quackenbush, 100; Henry Bell & Sons, Milton, N. Y., 100; Williams & Powers, Cohoes, N. Y., 100; Hudson Valley Knitting Co., Waterford, N. Y., 150; Myers & Parker, Fultonville, 100; besides a U. S. plant of 100 lights in F. O. Pierce & Co's. paint works, Brooklyn, N. Y. On Dec. 10, he closed a contract for his fifty-second knitting mill. It will be seen that Mr. Bernard can make sales despite the dull times, but even the above record is incomplete as he has also, in addition, placed over 50 firms and corporations on his books with orders for supplies, watchman's time detectors, etc. He expects also to have a general supply store running in Troy by January 1, and will then make his permanent change of address to that place. Mr. Bernard is doing all this work on the most conservative basis, and is in shape to carry on an enormous business, which will certainly not be lessened by the promptness with which he fills orders—one plant of a 100 light machine and 50 lamps having been put in complete in 2 days and another plant of a 100 light machine and 100 lamps in 4 days.

JAMES H. BATES.

The above named gentleman, who was formerly with the Sprague Co., afterwards with the local Edison Co., of Philadelphia, and more recently with the Fort Wayne Electric Co., has now located himself in New York, with headquarters at Moore Bros., 106 and 108 Liberty street, where he will carry on a business in general electrical supplies and will handle electric motors. His activity, knowledge of the trade, and wide acquaintance should bring him plenty of business.

NEW ENGLAND TRADE NOTES.

MR. F. H. LOVEJOY, for many years connected with the Wainwright Manufacturing Company of Massachusetts, has resigned his position with that company. Mr. Lovejoy is well known in the vicinity as an energetic salesman and has not yet decided where he will be located in the future.

THE STANDARD ELECTRIC CO. OF VERMONT have sold a 500 light plant to the Lebanon Building and Power Company of Lebanon, N. H.

CLAFLIN AND KIMBALL.—The business of the Mather Electric Co., and the Perkins Electric Lamp Co., conducted in New England through their agents, Messrs. Claflin & Kimball, has increased so rapidly that they have been obliged to remove to larger offices in the new building of the Shoe and Leather Association, on Bedford and Kingston streets, Boston. This change, made necessary by the rapid expansion of their business, provides the above company with very convenient and accessible offices. The business of the firm has more than trebled each year for the past three years, and this year they have sold and installed apparatus for incandescent electric lighting in isolated plants alone, nearly 9,000 lights since the 1st of February.

THE PERKINS ELECTRIC LAMP CO. are now manufacturing about 5,000 lamps a day, and are still away behind on orders.

WESTERN TRADE NOTES.

MR. WM. B. KNIGHT the prominent electric railroad contractor of Kansas City, was badly scalded in the recent accident on the Wabash road at Jacksonville.

THE ILLINOIS ELECTRIC MATERIAL CO., Rookery, Chicago, have just been appointed General Western agents for all the new and valuable specialities of the well-known Star Electrix Company, of Philadelphia. Amongst others those of special merit are the new electric switch and cut-out, and also a highly ingenious and effective lamp socket which is very readily wired and remarkably handsome in finish and very durable.

MR. THOMAS WRIGLEY, 85 Fifth avenue, Chicago, whose ingenious vertically adjustable dynamo support was fully illustrated and described in the last issue of THE ELECTRICAL ENGINEER, has furnished the city for use in their power house, at Troop and Van Buren streets, ten of his supports, where they are doing excellent and most efficient service. Those who are running belts vertically to connect the engine pulley with that of the dynamo should provide themselves with this very useful device.

MR. H. K. GILMAN, who has become so widely and favorably known amongst the electrical fraternity all over the country from his long connection with the Northwest-Thomson Houston Electric Company as its assistant general manager, and to whose work the prosperity and extensive business of that flourishing concern is largely due, has now come to reside in Chicago and take the managership of The Great Western Electric Supply Company, in the carrying out of which he is certain to achieve the most signal success. Mr. H. K. Gilman was an officer in the navy and has a host of warm friends in the service, who will be glad to know of his many brilliant results in the field of electrical work. He is another of the navy men who have made their mark in the service and later turned their attention to the electrical profession with the most happy results, seeming to be peculiarly fitted to it by their early naval training. The list now includes such men as Shallenberger, Gilman, Dana Greene, Louis Duncan, Gilbert Wilkes, Wood, Cahoon, Colvin and others.

MR. S. W. HUME, special agent of *Power-Steam*, was a visitor to Chicago last week. Mr. Hume was busily engaged while here in looking up the numerous friends and patrons of his journal.

THE
Electrical Engineer.

VOL. X. DECEMBER 24, 1890. No. 138.

SOME MEASUREMENTS THAT ARE CONVENIENTLY ACCOMPLISHED IN PRACTICE BY THE WESTON HIGH RESISTANCE VOLTMETER.

BY OSBORN P. LOOMIS.

IN the following I have attempted to give a practical description of some methods of applying a high resistance voltmeter to the ordinary measurements that occur in the every day life of the electrical engineer. It is attempted to make them as clear as possible, and probably more so than is necessary to many, who may also have used the same method with various modifications; to others, however, they may prove of interest and value.

The first application I will mention is that of measuring approximately the insulation resistance of line work, etc. In the diagram, Fig. 1, is shown a system of wiring in which we will suppose there is a leak at X. By providing a ground at another suitable place, and attaching the voltmeter as shown, take a reading on the ground circuit, and call it V. Then take the full E. M. F. of the line, calling it

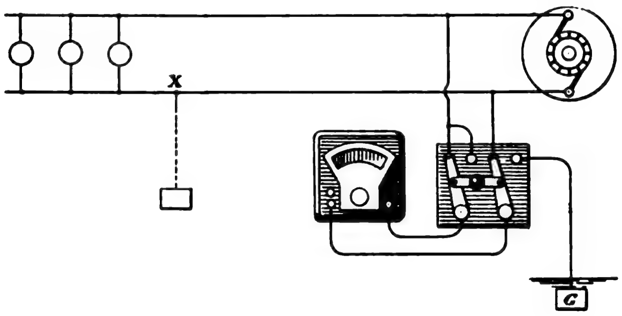


FIG. 1.—LOCATING A GROUND LEAK.

V'. Knowing the resistance (R) of the voltmeter, the resistance of X or the ground leak will be $\frac{V' R}{V} - R.$

The following is an example:
Ground reading, 20 volts (V). Line reading, 120 volts (V'). Voltmeter resistance, 16,660 ohms (R).
Applying the formula we get,

$$\frac{120 \times 16,660}{20} - 16,660 = 99,960 - 16,660 = 83,300 \text{ ohms.}$$

The line insulation resistance is therefore equal to 83,300 ohms.

In this manner insulation resistances may be measured up to one megohm and at any time while the circuits are in operation, the convenient connecting switches being permanently arranged on the switchboard. In this way interesting data can be obtained regarding the effect of different states of weather on the line.

This principle can be applied to the measurement of the resistance of the human body, and it is a much more desirable method than by the Wheatstone bridge. Fig. 2 shows the arrangement in detail.

Two glass jars are provided, each containing a weak solution of caustic potash, and copper plates connected in series with the voltmeter and dynamo, or a battery of small storage cells to be described later. It is desirable to run the voltage up as high as the subject can endure, which may be 140 volts. Then the jars are short-circuited by the key and another reading is taken. Calling the first

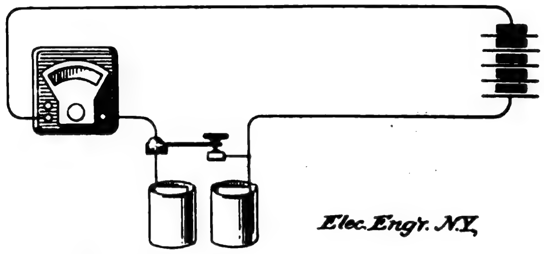


FIG. 2.—MEASURING RESISTANCE OF THE HUMAN BODY.

reading V and the second reading V', and the resistance of the voltmeter (R) the result is found as in the previously mentioned insulation resistance, viz.: $\frac{V' R}{V} - R.$

Here is an example:
Subject in circuit, 140 volts (V).
Voltmeter alone, 149 volts (V_1); resistance of voltmeter, 16,660 ohms (R).
Applying the formula,

$$\frac{149 \times 16,660}{140} - 16,660 = 1,731 - 1,660 = 1,071 \text{ ohms.}$$

If the circuit-closing key is opened while the subject's hands are in the solution, the sudden shock will be very unpleasant; but by immersing the hands while the current is on it can be endured quite readily, as the volume of current will probably not exceed 9 milliamperes with 150 volts on the voltmeter. It is, of course, obvious that a high resistance voltmeter is absolutely necessary in these measurements; in fact, the higher it is, the better.

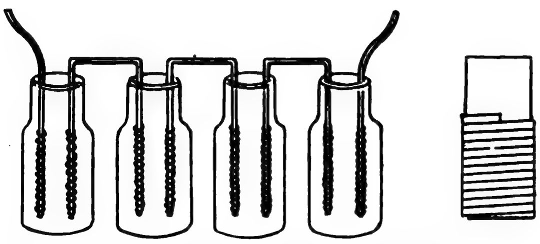


FIG. 3.—SIMPLE STORAGE BATTERY FOR TESTING.

Right here I will mention a simply made storage battery for these and other measurements. Procure about 72 large-mouthed bottles, about 2½ inches in diameter and 6 or 8 inches deep. Make the plates of lead strips with other very narrow strips of lead wound around the portion which is immersed in the acid. To save the trouble of numerous connections, make one strip long enough to reach over into both bottles with the afore-mentioned wound portion on each end. The arrangement is shown in Fig. 3.

They are usually charged in two rows in multiple, as ordinary incandescent circuits do not give the requisite E. M. F. in series. A switch is used, Fig. 4, which quickly throws them in series and multiple with the discharging circuit. One of the uses of this battery is in photometry work; as the current gradually falls, it is started at a higher E. M. F. than the standard and the screen watched when the balance is obtained; then a signal is given and the E. M. F. and current are read by other parties, so that the efficiency for any given candle-power is obtained.

We now come to the internal resistance of batteries, in which no ammeter is required, but a standard resistance, Fig. 5, made of heavy German silver or platinoid wire, about No. 7 or 8 gauge. Ten spirals wound right and left handed and placed alternately, to avoid magnetic effect as far as possible, are arranged to be connected in series or multiple by large brass screws. By this arrangement it can be measured in series or multiple and any error can be found that might exist where only the low resistance could be measured. This resistance is conveniently adjusted to 1/100 of an ohm in multiple; in series it would be 1 ohm measured in legal units. In this combination a variety of work can be accomplished.

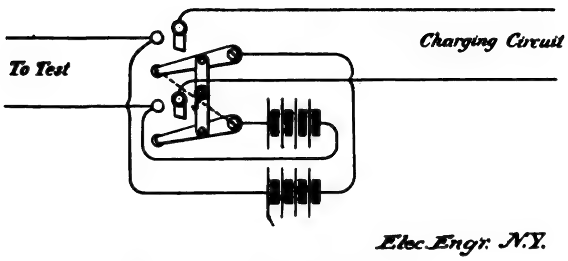


Fig. 4.—Charging Switch.

To measure the resistance of an accumulator, connect up as shown in Fig. 5. Take a reading of the E. M. F. with the cell on open circuit and call it V; then close the circuit through the standard resistance and call the decreased E. M. F., V'. Then the internal resistance of the accumulator is $\dfrac{V - V'}{\dfrac{V'}{\text{Stand. } R}}$

The following is an example:

E. M. F. on open circuit, 2.15 volts; E. M. F., discharging through standard resistance of .01 ohm, 1.43 volt. Then, by the formula, the internal resistance of the cell is,

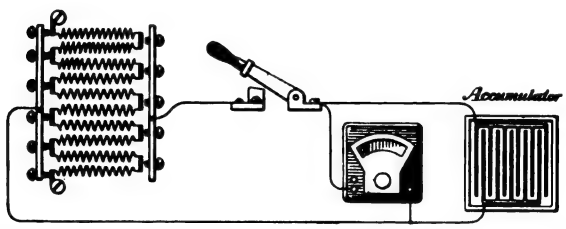


Fig. 5.—Measuring The Internal Resistance of Batteries.

$$\frac{2.15 - 1.43}{\dfrac{1.43}{.01}} = \frac{.72}{143} = .005 \text{ ohm.}$$

In this experiment the connections and conductors must be as large as possible so as to avoid any errors from that source; but they may be obviated entirely by taking the P. D. directly off the terminals of the battery and the terminals of the resistance beyond the point of connection. This is only an application of Ohm's law pure and simple, and it is because of its simplicity that makes it so valuable.

I might mention that in this method it is necessary to have the double-reading voltmeter, but the internal resistance of a group of cells can be found quite readily by the single-reading voltmeter, and then the average resistance, of course, can be found. Say, we have a group of 10 cells and the standard resistance is changed to 1 ohm. If we get 21 volts on an open circuit and, closing the circuit through the resistance, it drops to 20 volts, then the internal resistance of the group of 10 cells will be,

$$\frac{21 - 20}{\dfrac{20}{1}} = \frac{1}{20} \text{ or, .05 ohm, total resistance.}$$

$$\text{Hence, the resistance of 1 cell is } \frac{.05}{10} = .005 \text{ ohm.}$$

The internal resistance of batteries can also be obtained by the charging current as well as the discharging; for, suppose in charging 25 cells we observe by an ammeter 30 amperes flowing in the circuit and their P. D. is 56.8 volts. Upon taking off the current and observing *the instant* the needle stops falling (the instrument being so "dead beat" that there is very slight oscillation after the current is disconnected) it shows 50 volts; then the internal resistance is,

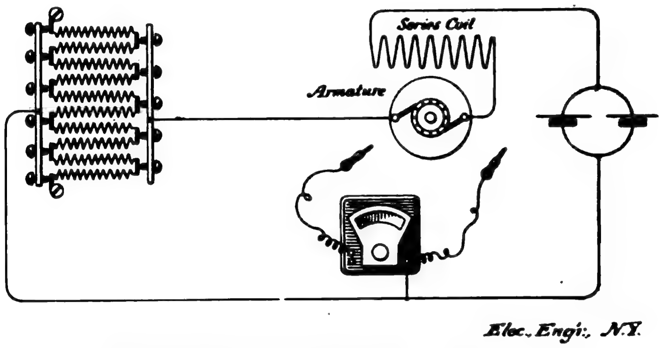


Fig. 6.—Measuring Low Resistances.

$$\frac{56.8 - 50}{\dfrac{50}{1}} = \frac{6.8}{50} = .136 \text{ ohm, total; or } \frac{.136}{25} = .005 \text{ ohm per cell.}$$

This method is not as accurate as the preceding one, but can be used in the case of primary batteries which polarize rapidly on a discharge.

The next application is to the measurement of low resistances by the low-reading scale of the voltmeter, such as armatures and series-coils of compound dynamo machines. As shown in Fig. 6, put the standard resistance of .01 ohm in series with the armature, series-coil and an accumulator, or, better, several accumulators in parallel. Take the P. D. of the standard resistance and call it V; then the P. D. of the armature, calling it V'. The resistance of the armature will be

$$\frac{V' \text{ (Stand. } R.\text{)}}{V}$$

Example:

P. D. at Stand. $R.$ = 2.35 v. (V); P. D. Armature = 3.15 v. (V')

Applying the formula,

$$\frac{3.15 \times .01}{2.35} = .013 \text{ ohm.}$$

The resistance of the series-coil is found in the same way. To check errors from the diminution of current between readings, they should be gone over twice. This same stand

ard resistance can be used to measure currents of comparatively large magnitude, say, up to 400 amperes. It is best to take the readings as quickly as possible to avoid the temperature error, which, while not large, it is better to avoid as much as possible.

In this measurement the P. D. observed, divided by the standard resistance, equals the current. For example, suppose we obtain the P. D. of 2.55 volts and the standard resistance was .01 ohm; there would then be 255 amperes flowing in the circuit. I find this very useful in calibrating ammeters, using 6 or 8 cells of accumulators of large type connected two in series and three or four in multiple. In this way it is possible to obtain 300 amperes long enough to secure a reading. Smaller currents may be obtained by a resistance introduced in the circuit, generally a german silver strip with a heavy sliding contact.

For reading for 1 to 15 amperes, use the coils in the resistance put in series, and the P. D. (if the resistance is 1 ohm) will be in terms of the current. It is seen that quite a range of work can be obtained. Sometimes it is desired to read a higher E. M. F. than the voltmeter is graduated to do. By introducing the resistance, of course, the reading is reduced. Add the resistance of the voltmeter (with which they are all accurately marked) and the reading will be halved. This resistance being so high is the most troublesome to make. A very convenient way is to take a piece of ground glass marked with graphite and measured

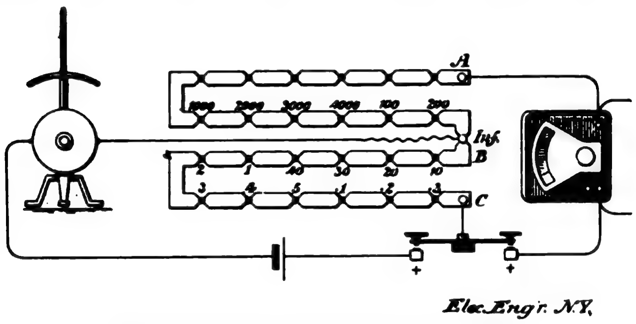


FIG. 7.—CALIBRATING THE VOLTMETER.

by the Wheatstone bridge and finally adjusted with the voltmeter.

To verify the reading of the voltmeter at any time, or, in other words, to compare it with a standard cell, take an ordinary resistance box (legal or B. A. ohms), and connected as shown in Fig. 7, using two keys (generally those on the box), the first one to close the circuit through the total resistance from A to C, and the other to close the standard cell through the galvanometer. If we are reading about 100 volts, and unplug 5,000 ohms between A and B, then we unplug enough between B and C to obtain a balance in the standard cell circuit. It is advisable to have the least possible current flow through the standard cell, and at the commencement it is convenient to know approximately what resistance to unplug between B and C so that the balance will be nearly obtained upon the first trial. For example, suppose we have unplugged 5,000 ohms between A and B and we observe that the E. M. F. to be tested is about 112 volts and the standard cell is 1.444 volt. Multiply the 5,000 by 1.444 and divide the product by 112—1.444; the result will be approximately the number of ohms to unplug from B to C. Thus,

$$\frac{5000 \times 1.444}{112 - 1.444} = \frac{7220}{110.556} = 65.3 \text{ ohms.}$$

This is merely to save the trouble of hunting around after a balance, as well as to avoid unnecessary current passing through the standard cell; after this is done, however, we disregard the reading on the voltmeter and fall back on the standard cell E. M. F. as the standard. When this is done the total E. M. F. will be $\frac{(R + R')\,V}{R'}$, where R equals the resistance between A and B; R', the resistance between B and C; and V, the E. M. F. of the standard cell.

Example: Resistance unplugged between A and B, 5,000 ohms; resistance unplugged between B and C, 66 ohms.

Applying the formula, $\frac{(5{,}000 + 66)\ 1.444}{66} = 110.7$ volts.

In this method it is necessary to observe the position of the needle very carefully at the instant the balance is obtained, and not observe one and then the other with any large interval of time, for, with a sensitive galvanometer changes of .1 volt in 100 are easily detected. The connection at INF. is made by a cord and plug, the plug being made to fit the holes which are on the box. By this means this contact can be made at any point desired.

I will add to this article some points of interest to operators generally, as they may obviate some of the troubles that have come to others. This instrument, sensitive as it is to $\frac{1}{10}$ of 1 per cent., should receive a corresponding amount of good usage. No one would think of slamming a good watch around; yet the jewels and pivots of these instruments are as carefully made and adjusted as in a fine watch.

Being affected by magnetism, close proximity to all powerful magnetic fields should be avoided. Of course a nice voltmeter looks neat on a switch-board, but, surrounded by bus bars carrying heavy currents, that is far from the best place for it. It is better to put it in a place by itself at least 12 feet away from the conductors and dynamo, in fact, the further, the better, to secure accurate results. As only small wires are necessary to connect with the mains the above arrangement will cause little inconvenience. Of course it is unnecessary to state that it should never be carried near a dynamo, much less laid on the top of one, while in operation.

I will also call attention to the low temperature error that exists with this instrument. There being no copper wire of any consequence in the circuit, the current is so very small on account of its high resistance, that it can be left on the circuit indefinitely; it can also be used in the ordinary differences of surrounding temperature, with only an error of a fraction of 1 per cent. I will state that some of these instruments, after having been in use for three years, have been calibrated and agreed perfectly with the original, showing that, when handled properly, their permanency is unaffected.

NOTE ON PROFESSOR SHELDON'S EXPERIMENT ON THE "MAGNETO-OPTICAL GENERATION OF ELECTRICITY."

BY C. F. BRACKETT AND S. T. DODD.

WE have endeavored to produce an electric current in the manner described by Professor Sheldon in the *American Journal of Science*, September, 1890, page 196[1]; and we have also endeavored to produce it by other, similar means which his experiment suggested; but with entirely negative results.

We first followed as nearly as possible the arrangement of Professor Sheldon; the only essential change which we made was in the substitution of a glass tube for the brass one on which the coil was wound. The experiment was carried out with the result that faint musical sounds were heard in the telephone, which could be referred either to the action of the arc lamp or to the moving machinery. On interrupting the ray of light no change whatever was produced.

We next discarded the oscillating apparatus and substituted one by means of which we could rotate the Nicol prism about 200 times per second. For, if Professor

1. THE ELECTRICAL ENGINEER, December 3.

Sheldon's reasoning be correct, a rotation of the plane of polarization through 360°, 200 times per second, ought to produce an electromotive force higher than would be produced by the oscillation of the mirror reflecting the beam 300 times per second. We failed, however, to obtain any indication of a direct current by the use of a delicate galvanometer, or of an interrupted current by means of a telephone, when the ray of light was rapidly and periodically interrupted.

In the third place, if an electromotive force can be induced by mechanically superimposing a third rotation upon the two existing rotations which are regarded as the equivalent of a plane polarized ray, then a still greater electromotive force should be induced by suppressing one of the original rotations; that is to say, by using circularly polarized light. Accordingly this plan was employed and with negative results.

It occurs to us to remark in reference to the general subject:

(1.) That an oversight has been made, by Professor Sheldon, in a matter of such extreme delicacy, in the employment of a conducting core for the helix instead of a nonconducting one.

(2.) That an arc light is wholly unsuited to be employed in such an investigation. Finding that the currents set up in the helix, by the variations of the magnetic field about the arc, were sufficient to mask any effect that we might hope for, we were forced to employ the calcium light instead.

(3.) Professor Sheldon does not state the material of which his mirror was made. If it was of glass, Fresnel's formulæ for the reflection of polarized light would show that, at an incidence of 80° to 85°, a rotation of the mirror through an angle of 45° would only produce a rotation of about 10° in the plane of polarization of the reflected beam. If the mirror was silvered, according to Jamin's experiments on metallic reflection, the reflected beam would be plane polarized only in case the angle between the planes of polarization and reflection were 0° or 90°.

Electrical Laboratory,
Princeton, N. J., Dec. 18th, 1890.

TRANSMITTING PICTURES ELECTRICALLY.

BY W. S. EATON.

Some few months ago in the electrical journals appeared a new method of sending pictures by telegraph. Briefly stated, the process was to divide the picture to be sent into squares, and each square was numbered to correspond with a paper similarly prepared and to be used at a distant point to draw upon, according to the direction sent from the transmitting station by the number communicated.

The example illustrated in the article alluded to, particularly impressed the writer with its very mechanical appearance. Every line was necessarily a straight one, and as the outline, only, of the picture could be thus communicated, it seemed to him that the idea, although an exceedingly good one, was altogether inadequate for practical purposes, to say nothing of its utter impracticability as applied to portraits.

When the Bell telephone was brought out as a commercial success, it opened up a vast array of new possibilities. It was simple enough, too; but it is singular, indeed, that these very simple things lie so long undiscovered.

I have apparently digressed from the subject and started to write on telephones, but this digression is more apparent than real, since the method of transmitting pictures electrically, which I shall venture to propose, is based upon principles inseparably connected with telephony.

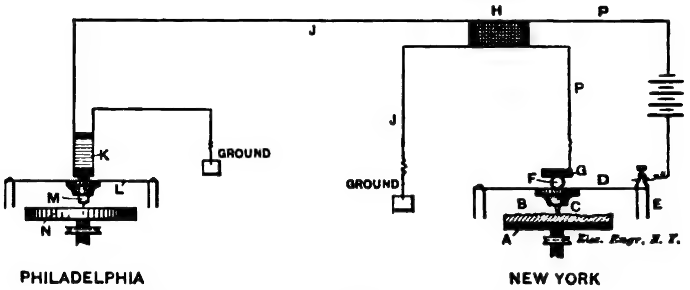
In order to make clear my idea, I must be permitted, for another brief interval, to depart from electricity and take up the wonderful chemical changes brought about by the action of light in the art of photography.

If we mix in proper proportion bichromate of potassium and gelatine we get a mixture that is highly sensitive to light. If now we coat a glass plate with collodion and then flow a moderately thick film of the bichromated gelatine thereon, and afterward expose this film to a strong light through a negative, the parts acted upon by the light become insoluble, and those parts protected from the light are easily soluble and capable of being washed out. After a suitable period this gelatine becomes so very hard that it is then possible to take an impression from it in soft metal. This is no discovery of mine; it is an old and much used idea.

To return to the electrical portion again. To transmit pictures electrically between, say, New York and Philadelphia, we arrange two machines, one at each end of the line and both working synchronously. This, it will at once be evident, is imperative.

We will suppose that we are sending from New York to Philadelphia. A revolving table A has mounted upon it a bichromated gelatine film treated as described above. This film is shown in cross section at B. It will be noted that the surface is irregular, corresponding in its elevations to the lights and darks of the picture. It is, in fact, a perfect picture in intaglio.

A tracing point C, mounted under the diaphragm D, works, or rather rests, lightly on the surface of the film. The diaphragm is supported at E E, and is connected to one pole of a galvanic battery. F is a platinum contact and G



Transmitting Pictures Electrically.

a carbon button. P P are the primary wires leading to the induction coil H.

The action will now be easily understood. The table A is slowly revolved, and the diaphragm D, with its tracing point C, is fed slowly from the outer edge toward the centre. The elevations and depressions of the picture cause the diaphragm to vibrate, and a greater or less current passes through the primary circuit to the induction coil, varying, of course, with the amplitude of vibration of the diaphragm, and its corresponding pressure of the carbon button G.

The secondary wires J J are led one to ground and the other to the distant station to the electro-magnet K. The varying impulses from the secondary acting through the magnet K causes the diaphragm L to repeat every movement of the transmitting instrument D.

In the receiving instrument we replace the tracing point with a lead pencil or other marking device, and stretch upon the table N a sheet of paper. The movements of the tables A and N are rotary and synchronous. The transverse motions of the tracer C and the lead pencil M are at the same speed; consequently, with each electrical impulse, we obtain at the receiving station a line either dark or light, as the vibration of the transmitting diaphragm has been great or small, and finally we finish with a perfectly shaded picture, an exact reproduction in chiaroscuro of the original photograph.

ELECTRIC CARS IN ROCHESTER, N. Y.

Electric cars have quickly made their way into popular favor in Rochester. The Rochester Railway Co. are running 12 electric cars on the Lake and South avenue lines, the power being furnished from the plant of the local Brush Electric Light Co. The receipts per day average 150 per cent. more than they did under the old horse car regime.

THE EICKEMEYER STREET RAILWAY MOTOR.

Our readers will recall the fact that during the summer of 1887 Mr. Stephen D. Field operated an electric locomotive on the 34th street branch of the elevated railroad in this city. The essential feature of this locomotive lay in the fact that the machine was designed with a very powerful torque, and that the armature was provided with a crank and geared direct to the drivers by a connecting rod. This was a decided departure in electric railway work and was watched with considerable interest by all concerned in the solution of the electric railway problem. The results obtained on that occasion convinced the designer of the correctness of his principle, and shortly afterwards a street car was constructed on an analogous principle, in which the well-known Eickemeyer motor was employed as the driving power. This car, constructed some two years ago, at Yonkers, was put in operation at Steinway, N. Y., and though not differing from the original design has operated to entire satisfaction.

Our engraving, Fig. 3, shows the car as it stands on the track. The Eickemeyer motor employed is geared direct to the drivers, which are 18 inches in diameter, the radius of the crank being 3 inches. The motor, which is capable of developing 25 h. p. at 300 volts, weighs about 2,400 pounds. The armature is 12 inches in diameter and 17½ inches long, and upon it are wound four layers of No. 9 B. & S. gauge, having 560 turns, equal to a resistance of .65 ohm. The field consists of 900 turns of No. 8 B. & S. wire, and is in series with the armature and by means of the switch can be grouped into various combinations of sections, either parallel or series, and when all in parallel has a resistance of .3 ohm. At 150 revolutions of the motor the car has a speed of 8½ miles an hour.

We have had occasion recently to inspect this road and to ride upon the car, and from actual experience can assert that in ease of starting and evenness of motion, the car leaves nothing to be desired. It was able to overcome quite a severe curve and grade with the greatest ease. It was also noteworthy that the momentary increase of current upon starting the car was but a very small fraction above that ordinarily required for propulsion, as the counter E. M. F. of the armature was immediately developed on account of the intense field.

Among the roads which will shortly be equipped with the Eickemeyer system is that at Lynchburg, Va., and the engravings, Figs. 2 and 1, show a side elevation and plan of the trucks which will be employed there. The motors are larger than the one just described and weigh 3,500 pounds. The diameter of the armature is 13¾ inches and its length 18½ inches. It is wound with three layers of No. 10 B. & S. wire, having 440 turns and a resistance of .7 ohm. The field is of No. 9 B. & S. wire and has a resistance of .6 ohm with all the coils in parallel. The motor, which is designed to develop 35 h. p. at 500 volts, will be geared

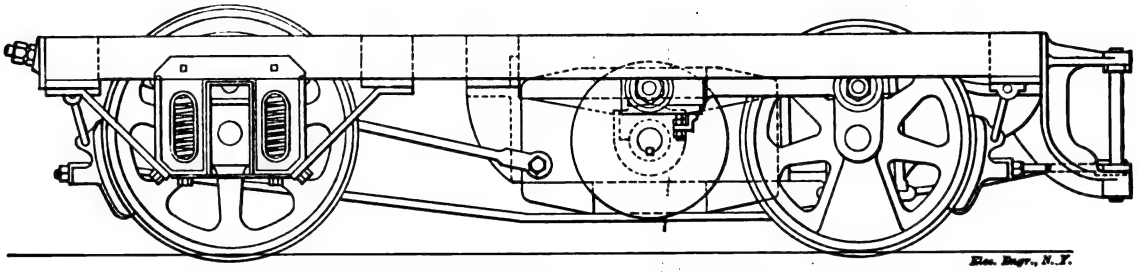


Fig. 2.—Eickemeyer Direct Geared Electric Railway Truck.

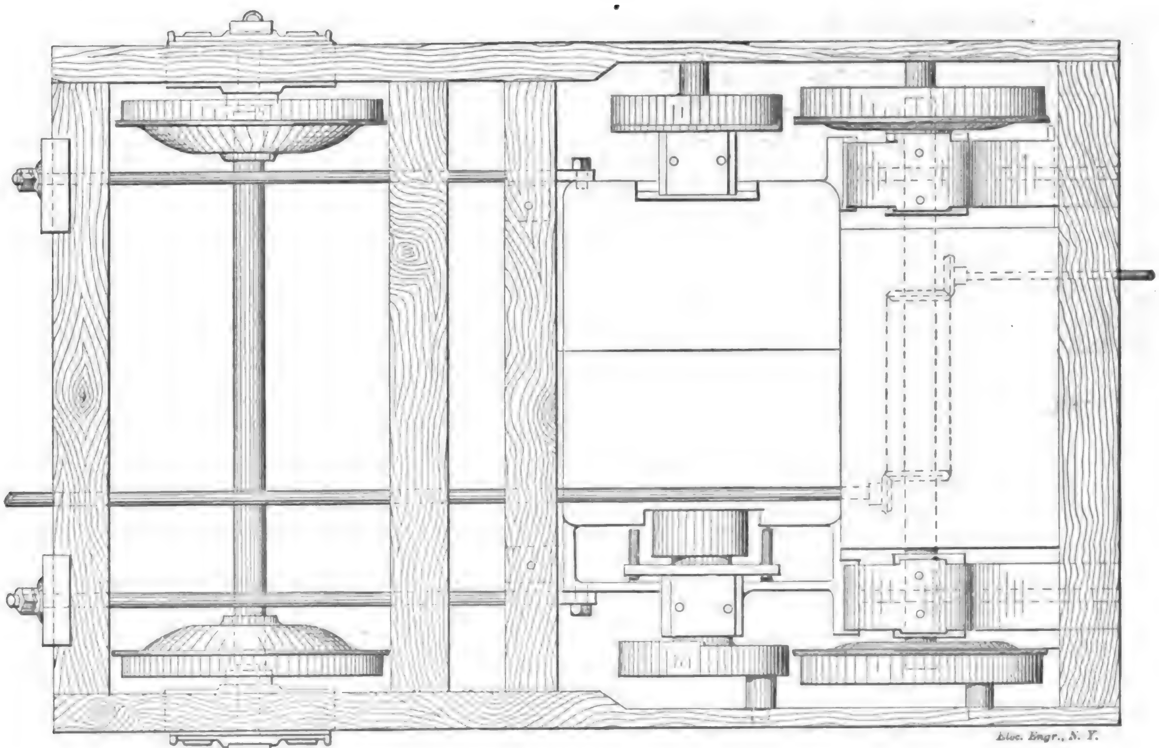


Fig. 1.—Eickemeyer Direct Geared Electric Railway Truck.

directly to the drivers by a five-inch crank, the drivers being 26 inches in diameter. Under these conditions a speed of 10 miles per hour will be attainable with only 120 revolutions per minute of the motor.

As in Mr. Eickemeyer's dynamos, these motors are all supplied with carbon brushes, but unlike the usual type of solid blocks, a multiplicity of contacts is obtained by securing a series of carbon buttons to a spring plate, which presses them against the commutator and thus provides a number of contacts for the path of the current. As before remarked, the momentary increase of current upon starting the car is exceedingly small in the Eickemeyer motors, which is largely due to the great density of field employed. Thus in the armature a density of no less than 110,000 lines per square inch is used. Preparations are now actively going forward and the Lynchburg road will shortly be put in operation, being equipped with Eickemeyer generators in the motive plant.

FIG. 3.—EICKEMEYER ELECTRIC STREET CAR.

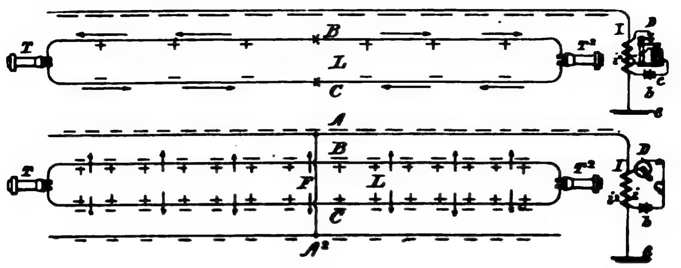
CARTY'S METHOD OF REDUCING INDUCTION IN TELEPHONE CIRCUITS.

IN a most interesting lecture delivered last winter before the New York Electric Club, Mr. J. J. Carty, electrician of the Metropolitan Telephone Co., of this city, showed how, besides the disturbances caused by dynamic induction between wire and wire, others of no less importance and effect were caused by static induction; and further, that while a circuit might be balanced dynamically with respect to a neighboring telephone circuit, if unbalanced statically, disturbances might be produced on the telephone circuit.

Let us suppose for instance that in the accompanying diagram A is the disturbing wire, which we will consider as being discontinuous at the outer end and as being at a given moment charged to a definite negative potential by the circuit breaker D, which interrupts the current of the battery in a local circuit, within which the primary helix of the induction coil I is included. The secondary helix I^2 of the induction-coil is in the line-circuit, and the entire apparatus may be regarded as the source of sound.

The negative charge on A of course tends to induce an equal positive charge, indicated by the plus-symbol on the line-wire B of the parallel metallic circuit L, and consequently a negative charge of like amount on the more distant linear conductor C of the same circuit.

Speaking conventionally, we may say that the electricity of the circuit L is decomposed, a positive charge being attracted to the side B nearest to the inducing charged wire, while a corresponding charge of negative sign is repelled



FIGS. 1 AND 2.—CARTY'S METHOD OF BALANCING TELEPHONE CIRCUITS ELECTROSTATICALLY.

to the more distant conducting-surface of C. This redistribution results, of course, in currents through telephones T and T^2, producing noise corresponding to the note given out by the circuit breaker, and if the disturbing-line A were engaged in telephonic transmission the telephones T and T^2 would reproduce the speech transmitted over A.

To prevent this inductive interference therefore, Mr. Carty has designed and patented the arrangement of circuits shown in Fig. 2. The metallic telephone-circuit L is identical with that shown in Fig. 1, the telephone T being included therein at one end and the telephone T^2 at the other. The disturbing conductor A, having an earth terminal *e* and provided with the induction coil I, through which vibratory impulses are thrown on to the line tending to produce a musical note and actually establishing thereon, as long as the line is open, a varying potential, is now provided with an associate line-conductor A^2, holding the same inductive relation to the conductor C of the metallic circuit L as does A to the conductor B; that is, the wire A^2 is run parallel to, and for the same length as, C and at the same distance therefrom as A is from B. A cross-wire or connecting-conductor F, located at any suitable point of the line, unites A and A^2. When these are joined, as shown, the disturbing wire being operative, no sound is heard either at T or T^2.

This is readily explained by a consideration of the conditions, for A^2 being at all times at the same potential as A, acts with the same force as C that A does on B, and while A does, indeed, tend at any given moment to attract a

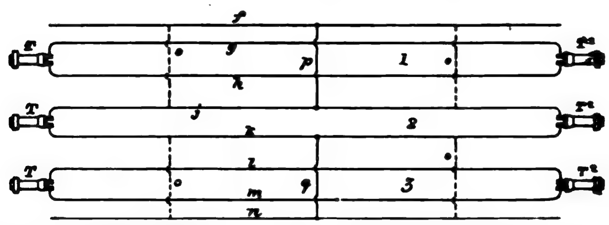


FIG. 3.—CARTY'S METHOD OF BALANCING TELEPHONE CIRCUITS ELECTROSTATICALLY.

positive charge on B and to repel an equal and opposite charge to C, it is also true that its associate conductor A^2, electrified at the same moment to the same potential, tends to attract a positive charge to C and to repel an equal and opposite charge to B. The resultant effect is, of course, zero, or neutrality, or, as indicated by the arrows, the flow or rearrangement of the charge will be lateral and the telephone T and T^2 will be silent.

The diagram, Fig, 3, shows one manner in which the principles just pointed out can be practically applied three metallic circuits being shown. By this arrangement the circuits 1, 2 and 3 are freed from disturbance due

to electrostatic induction. The action of the compensating wires f and n is like that of a condenser, each wire acting as one plate.

It will be apparent, therefore, that they may be replaced by a series of condensers distributed along the line, their total capacity equaling the capacity of the compensating wire which they replace.

A PRACTICAL GUIDE TO THE TESTING OF INSULATED WIRES AND CABLES.—VI.

(*Copyright, The Electrical Engineer.*)

BY HERBERT LAWS WEBB.

BRIDGES.

The Post-office form of bridge, illustrated in Fig. 22, is smaller and more compact than the dial pattern and is therefore more suitable for out-door work than for laboratory use. Its range is more limited as the proportional coils only contain three different resistances, 10, 100 and 1,000 ohms, instead of four; it can, therefore, only measure from .01 of an ohm to 1 megohm.

The adjustable coils are sixteen in number, their values being 4, 3, 2, and 1 in thousands, hundreds, tens and units, giving any combination up to 9,999 ohms. The coils are thrown in circuit by taking out plugs instead of putting them in, as in the dial bridge, and the resistance measured is ascertained by adding up the values of the various coils unplugged, which is not quite such a simple operation as reading off a figure from each of four dials. The two small keys fixed in front of the coils serve, the one on the right, for putting on the battery, and that on the left, for throwing the galvanometer in circuit. The right hand key is generally held down and the left tapped from time to time as the plugs are manipulated; in this way sudden throws of the galvanometer are avoided, the left hand key not being kept down for any length of time until an even balance is nearly obtained. A small clamp for holding the battery key down permanently would be a useful addition to a Post-office bridge, as the two hands of the observer would then be free for manipulating the plugs and the galvanometer key.

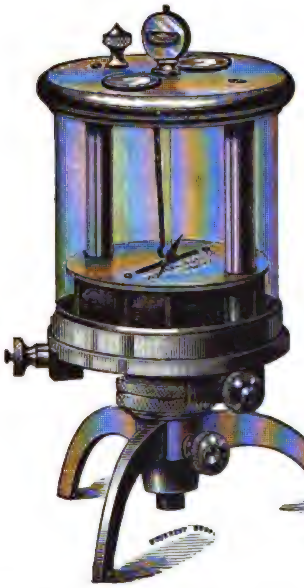


FIG. 23.—SMALL ASTATIC GALVANOMETER.

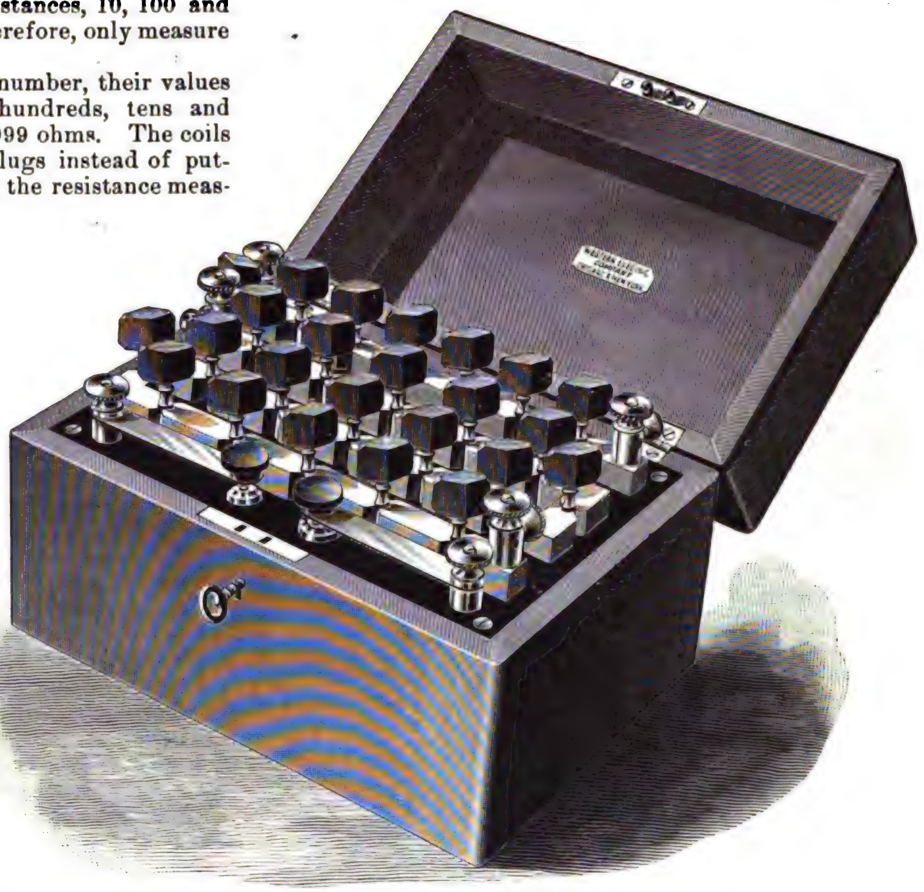


FIG. 22.—WHEATSTONE BRIDGE, POST OFFICE FORM.

The small astatic detector galvanometer, illustrated in Fig. 23, is an excellent little instrument for work-shop or factory use with a Post-office bridge. Its small size renders it available for portable work and it can be set up quickly and in places where a reflecting galvanometer would be out of the question, while it is sufficiently sensitive for ordinary resistance measurements.

A box containing adjustable resistance coils from 1 to 1,000 ohms is a useful adjunct to a set of testing instruments. As an instance of its usefulness, reference is only needed to the labor of working out the multiplying value of shunts of different resistances, whenever a shunt is required to a different value from any of the three unadjustable coils supplied with the galvanometer. Of course the resistance of a galvanometer varies considerably with the temperature, and a table of shunt resistances and multiplying values would be incorrect except at the temperature at which the resistance of the galvanometer was exactly that used in calculating the table. By connecting an adjustable resistance in circuit with the galvanometer the variation in resistance due to temperature may be made up and the resistance of the galvanometer kept always practically the same. In this way a table of shunts can be made out, giving the multiplying value for various resistances, using the formula given before, $\frac{G+S}{S}$. This arrangement, facilitating the use of shunts of various values, will be found very useful in factories where numbers of cables and wires have to be tested daily; the chief advantage being that the galvanometer can be shunted so as to give any desired deflection, large deflections, of course, being read with greater ease and accuracy than very small ones.

CONDENSERS.

The simplest method of measuring the electrostatic capacity of a wire or cable, is, as has already been stated, by comparing the charge or discharge with the charge or discharge of a standard condenser. A condenser is simply a Leyden jar arranged so as to occupy the smallest possible

space; the condensers used in telegraphy and telephony consist of leaves of tin foil separated by leaves of paraffined paper. In making condensers for standards for testing purposes a finer degree of adjustment is necessary and plates of mica are generally used for the insulating medium, instead of paraffined paper.

In the Leyden jar one surface of tin foil is connected to ground and the other to the source of electricity by means of which it is charged, the glass bottle serving as the separating medium or dielectric. In order to obtain a large charging surface the alternate plates of tin foil in a condenser are connected together, thus forming two large plates made up of a number of small ones, much as a number of cells of battery, connected in parallel, practically form one cell having very large plates. Each set of plates is connected to a brass block on the top of the case; when the condenser is in use one of these blocks is connected to earth and the other to the charging key.

The unit of capacity is the "farad." A condenser which would hold a charge of one coulomb at a differeuce of potential between the plates of one volt would have a capacity of one farad. Such a condenser would be of enormous size, and the farad is such an inconveniently large unit that it has been necessary to divide it by one million to arrive at a unit of reasonable proportions; consequently measurements of capacity are always expressed in microfarads or fractions thereof. Standard condensers were first made for submarine cable testing, and as the capacity of a submarine cable is about one-third of a microfarad per mile the standards were always made of that capacity for convenience in comparison.

For general work, however, a non-adjustable condenser is not at all a convenient instrument to deal with, as it is highly necessary to be able to vary the capacity of the condenser, using one-tenth, or one-fifth, or some other fraction of a microfarad, instead of always one-third. Until lately adjustable condensers have had one serious defect, namely, that the different sections could only be connected in parallel, instead of being arranged so as to be connected both in parallel and in series. Standard condensers are now made, however, so arranged that the various sections may be connected either in multiple or series, or the sections may be used as separate condensers if desired.

To appreciate the advantage of having a condenser arranged in this manner it is necessary to discuss briefly the laws governing the joint capacity of condensers connected in parallel and in series. These laws run on parallel lines to those referring to the joint resistance of divided circuits, but with condensers exactly opposite results are obtained, as by connecting them in parallel the capacity is increased, and by connecting them in series the capacity is diminished; with resistances the effect is reversed. Connecting in series increases the resistance and connecting in parallel or in "multiple arc" diminishes it.

If we have a number of condensers joined in parallel the joint capacity will be equal to the sum of their respective capacities. When we connect them in series a very different result is obtained; their joint capacity is then only a fraction of the capacity of a single condenser. When condensers are joined in series their joint capacity is determined by the same law that governs the joint resistance of parallel circuits. The joint resistance of two wires joined in parallel circuit is equal to their product divided by their sum, thus: $\frac{R_1\ R_2}{R_1 + R_2}$ ohms,

and the joint capacity of two condensers joined in series is expressed in the same manner:

$$\frac{F_1\ F_2}{F_1 + F_2} \text{ microfarads.}$$

If we have three condensers in series the joint capacity is

$$\frac{F_1\ F_2\ F_3}{F_1\ F_2 + F_1\ F_3 + F_2\ F_3}.$$

The joint capacity of any number of condensers connected in series may be arrived at in the same manner, or in simpler form it may be written thus:

$$\frac{1}{\frac{1}{F_1} + \frac{1}{F_2} + \frac{1}{F_3} + \frac{1}{F_4}, \text{ etc.}}$$

Putting this expression into words, it is evident that the joint capacity of a number of condensers joined in series is equal to the reciprocal of the sum of the reciprocals of their respective capacities.

Thus if we have a condenser having ten sections of a capacity of one-tenth of a microfarad each, the joint capacity of the ten sections connected in parallel will be one microfarad, and if one side of each section is permanently connected to the earth block the range of the condenser will be confined between one-tenth and one microfarad. If, however, the plates of each section are connected to insulated blocks so that the sections may be disconnected from the earth block and connected together in series, then the range of the condenser will be greatly increased as far as small fractions of a microfarad are concerned. If we connect the whole ten sections in series, the rule of "the reciprocal of the sum of the reciprocals" shows that the joint capacity will be .01 microfarad; therefore a condenser arranged in this manner has a range of capacities from .01 to 1 microfarad.

VARIATIONS IN THE E. M. F. OF CELLS.[1]

The description of the apparatus, the capillary electrometer, and method of working are given fully in the paper. The following conclusions are drawn from the results of the experiments:

I. When the metals, copper, silver, bismuth and mercury, are introduced into purified nitric acid of different degrees of concentration, and a couple made with platinum, the E. M. F. of such a cell increases considerably from an initial point until it reaches a constant and in most cases a maximum value. The rise of E. M. F. is attributed to the production of nitrous acid by the decomposition of the nitric acid, and the final value is considered to be due to the former acid only, while the initial value is due for the most part to the latter acid, though it is affected to a remarkable degree by the amount of impurity of nitrous acid, either initially present or produced by minute and unavoidable uncleanliness of the metallic strip and the containing vessel.

II. If nitrous acid has been previously added to the nitric acid, then the maximum E. M. F. is reached at once.

III. If the conditions—namely, increase of temperature, of impurity, and of concentration of acid—are such as would favor a more rapid solution of the metal, and consequently a more rapid production of nitrous acid, then the rise of E. M. F. is concomitantly more rapid.

IV. Conversely, if the conditions are unfavorable to the production of nitrous acid, the rise of E. M. F. is less rapid.

V. If any substance, such as urea, be added which would tend to destroy the nitrous acid as fast as it may be formed, then the rise of E. M. F. is extremely slow, being dependent upon the number of molecular impacts of the nitrous acid upon the surface of the metal. Thus, the results obtained by the electrometer are confirmatory of those obtained by the latter author with the chemical balance.

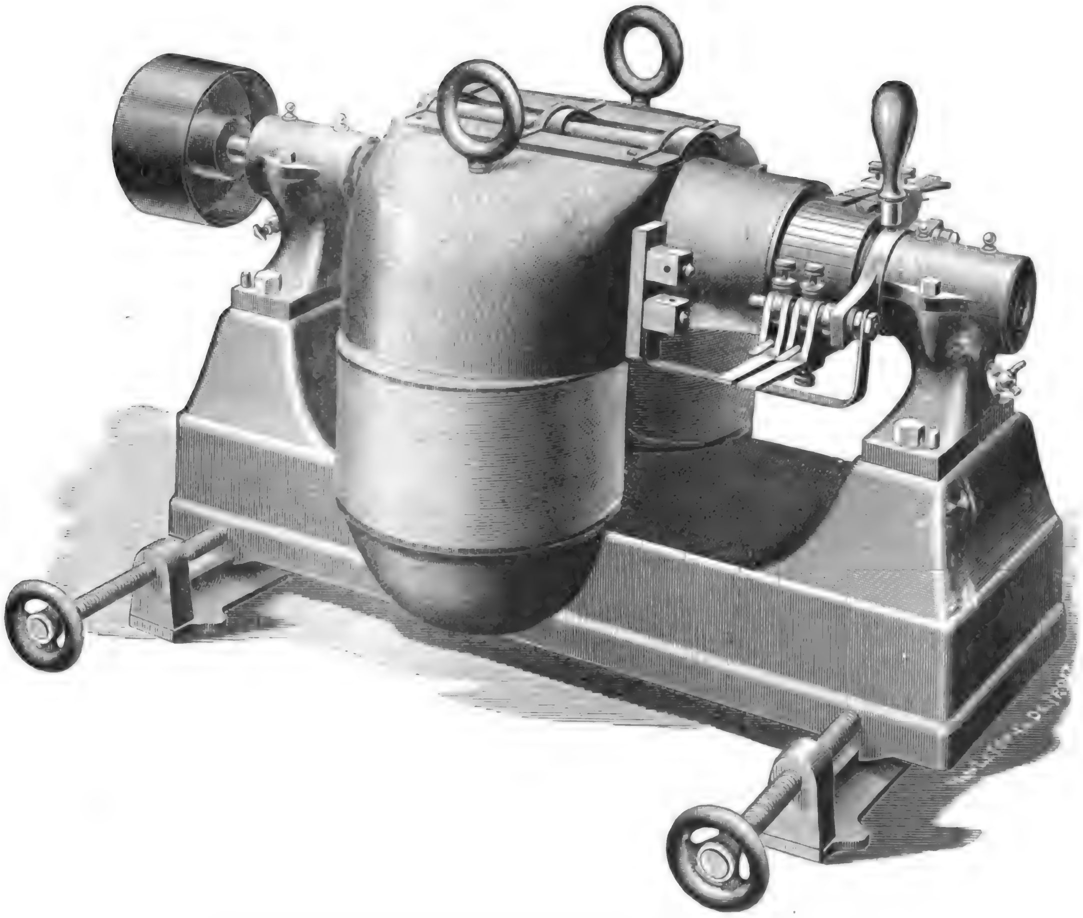
The authors propose to carry on further investigations on kindred problems.

[1] Abstract of a paper on "The Variations of E. M. F. of Cells, consisting of certain Metals, Platinum and Nitric Acid," read by Messrs. G. J. Burch and V. H. Veley, University Museum, Oxford, before the Royal Society, Nov. 27th, 1890.

THE BLADES DYNAMO.

The accompanying engraving illustrates the new dynamo designed by Mr. H. H. Blades, electrician of Detroit Electric Motor Co., in which attention has been devoted equally to the mechanical and electrical features.

The machine was designed to take advantage of the many good points of the single circuit, horse-shoe type of magnet and at the same time to eliminate and lessen some of the undesirable features of that type. It has been common in such machines to have a zinc or wood base interposed below the armature for the purpose of partially preventing short-circuiting of the magnetism. In the usual form of the inverted type, the moving parts, the armature and shaft, have been high above the centre of gravity; and in some, where the shaft is lower, cast-iron magnet cores of an oblong shape have been resorted to. In this machine it has been the purpose to avoid these features and at the same time to make the machine electrically and mechanically correct.



The Blades Dynamo of The Detroit Electric Motor Co.

The dynamo will be manufactured in 18 sizes, from one of 1,100 watts to one with a capacity of 160,000 watts, the patterns for all of which are finished. The 80,000 watt machine weighs 13,000 pounds and gives 145 amperes at 550 volts, running at a speed of 480 revolutions per minute. The magnetizing current at 550 volts is 1.2 ampere. The armature core of the 100 h.p. machine is 12 inches in diameter and 26 inches long. It is made up of about 850 charcoal iron discs, separated by paper, the oxide having first been removed from the surface of the iron. The magnet cores are of the softest forged iron.

A feature of the mechanical construction consists in a clearance hole bored through the centre of each magnet core. Through this hole passes a long bolt which screws into the bottom of the pole-piece, and the other end of the bolt is fastened with a nut under the yoke-bed, dowel-pins being employed to hold the parts in place. In this way the parts are more easily made interchangeable. The pole-pieces are bored on a form, the central points of which correspond with those on the bed-frame, making the matter of assembling an easy one.

THE RUMFORD MEDAL FOR HERTZ.

At the anniversary meeting of the Royal Society, held recently, the Rumford medal was presented to Prof. Heinrich Hertz, for his work in electro-magnetic radiation, and a Royal medal to Dr. J. Hopkinson, for his researches in magnetism and electricity. The society elected the officers and council for the ensuing year, and Sir William Thomson was chosen president in succession to Sir G. Stokes. In the evening Sir W. Thomson took the chair, as president, at the dinner of the Society at the Hôtel Métropole.

A PITHY PLEA FOR THE POLES.

The new poles for the incandescent light, which are now being put up in all parts of town, give evidence, says the Albuquerque, N. M., *Citizen*, that this new and improved electric light will soon be here. The new poles, in addition to those of the telegraph company, the arc light and the telephones, which are already here, make some of our streets regular forests of poles. Well, it looks like "business," and we shan't agitate the idea of putting the wires underground—at least not right away. Telegraph poles and railway tracks may cause some inconvenience when they become too numerous, but they constitute a compound nuisance which we have no disposition to abate. Let them multiply. Poles and tracks don't come where there is no business for them, and their presence here is the best evidence we can give to the public that the business of the town demands them.

MR. BRUSH'S WINDMILL ACCUMULATOR PLANT.[1]

The mill here shown, as well as all of the electrical apparatus used in connection with it, and the very complete system by which the results are secured, have been designed and carried out according to the plans of Mr. Charles F. Brush, of Cleveland, Ohio, and under his own personal supervision. As an example of thoroughgoing engineering work it cannot be excelled.

Every contingency is provided for, and the apparatus, from the huge wheel down to the current regulator, is entirely automatic.

The reader must not suppose that electric lighting by means of power supplied in this way is cheap because the wind costs nothing. On the contrary, the cost of the plant is so great as to more than offset the cheapness of the motive power. However, there is a great satisfaction in making use of one of nature's most unruly motive agents.

Passing along Euclid avenue in the beautiful city of Cleveland, one will notice the magnificent residence of Mr. Brush, behind which and some distance down the park may be seen, mounted high on a tower, the immense wheel which drives the electric plant to which we have referred. The tower is rectangular in form and about 60 feet high. It is mounted on a wrought iron gudgeon 14 inches in diameter and which extends 8 feet into the solid masonry below the ground level. The gudgeon projects 12 feet above the ground and enters boxes in the iron frame of the tower, the weight of the tower, which is 80,000 pounds, being borne by a step resting on the top of the gudgeon. The step is secured to a heavy spider fastened to the lower part of the frame of the tower.

In the upper part of the tower is journaled the main wheel shaft. This shaft is 20 feet long and 6½ inches in diameter. It is provided with self-oiling boxes 26 inches long, and carries the main pulley, which has a diameter of 8 feet and a face of 32 inches. The wheel, which is 56 feet in diameter, is secured to the shaft and is provided with 144 blades, which are twisted like those of screw propellers. The sail surface of the wheel is about 1,800 square feet, the length of the tail which turns the wheel toward the wind is 60 feet, and its width is 20 feet. The mill is made automatic by an auxiliary vane extending from one side, and serving to turn the wheel edgewise to the wind during a heavy gale. The tail may be folded against the tower parallel with the wheel, so as to present the edge of the wheel to the wind when the machinery is not in use. The countershaft arranged below the wheel shaft is 3½ inches in diameter, it carries a pulley 16 inches in diameter, with a face of 32 inches, which receives the main belt from the 8-foot pulley on the wheel shaft. This is a double belt 32 inches wide. The countershaft is provided with two driving pulleys each 6 feet in diameter, with a face of 6½ inches, and the dynamo is furnished on opposite ends of the armature shaft with pulleys which receive belts from the drive wheels on the countershaft.

The dynamo, which is one of Mr. Brush's own design, is mounted on a vertically sliding support and partially counterbalanced by a weighted lever. It will be seen that the countershaft is suspended from the main shaft by the main belt, and the dynamo is partly suspended from the countershaft by the driving belts. In this way the proper tension of the belts is always secured, the total load on the dynamo belts being 1,200 pounds, and on the main belt 4,200 pounds. The ends of the countershaft are journaled in sliding boxes connected by equalizing levers which cause both ends of the shaft to move alike. The pulleys are so proportioned that the dynamo makes fifty revolutions to one of the wheel. The speed of the dynamo at full load is 500 revolutions per minute, and its normal capacity at full load is 12,000 watts.

The automatic switching devices are arranged so that the dynamo goes into effective action at 330 revolutions a minute, and an automatic regulator is provided which does not permit the electromotive force to run above 90 volts at any speed. The working circuit is arranged to automatically close at 75 volts and open at 70 volts. The brushes on the dynamo are rocked automatically as the load changes. The field of the dynamo is slightly compounded. The current passes from the dynamo to contact shoes of polished and hardened steel carried by a cross bar on the tower, which shoes slide on annular plates surrounding the gudgeon. Conductors extend underground from these plates to the dwelling house. To guard against extraordinary wind pressure, the tower is provided at each of its corners with an arm projecting downwardly and outwardly, and carrying a caster wheel very near, but not in contact with, the circular rail concentric with the gudgeon. Ordinarily, these caster wheels do not touch the rail, but when the wind is very high, they come into contact with the rail and relieve the gudgeon from further strain.

In the basement of Mr. Brush's house there are 408 secondary battery cells arranged in twelve batteries of 34 cells each; these 12 batteries are charged and discharged in parallel; each cell has a capacity of 100 ampere hours. The jars which contain the elements of the battery are of glass, and each cell has its liquid covered with a layer of "mineral seal" oil, a quarter of an inch thick, which entirely prevents evaporation and spraying, and suppresses all odor. The automatic regulating devices are shown in one of the views of our engraving. At 1 are shown the voltmeters and ammeters employed in measuring the charging and discharging currents; at 2 is shown a series of indicators, one for each battery; 3 represents an electrically operated switch by means of which the current may be turned on or off the house mains by pressing push buttons in different portions of the house; 4 represents a ground detector, which is connected with the centre of the battery and with the ground, so that should the conductor upon either end of the battery be grounded, the fact will be indicated by the movement of the index in one direction or the other from the zero point of the scale, thus showing not only that the battery is grounded, but indicating the grounded pole; 5 is a leakage detector connected up with the lamp circuits, and arranged to show any leakage from one conductor to the other; at 6 is shown a compound relay for operating the automatic resistance shown at 7. This resistance is placed between the batteries and the house mains, and is arranged to keep the voltage on the lamps constant at all times. In this device the resistance is secured by means of powdered carbon placed under varying pressure, the necessary movement being made by means of hydraulic pressure under the control of the relays.

The house is furnished with 350 incandescent lights, varying from 10 to 50 candle power each. The lamps most commonly used are from 16 to 20 candle power; about 100 incandescent lights are in every day use. In addition to these lights there are two arc lights and three electric motors. It is found after continued use of this electric plant that the amount of attention required to keep it in working condition is practically nothing. It has been in constant operation more than two years, and has proved in every respect a complete success.

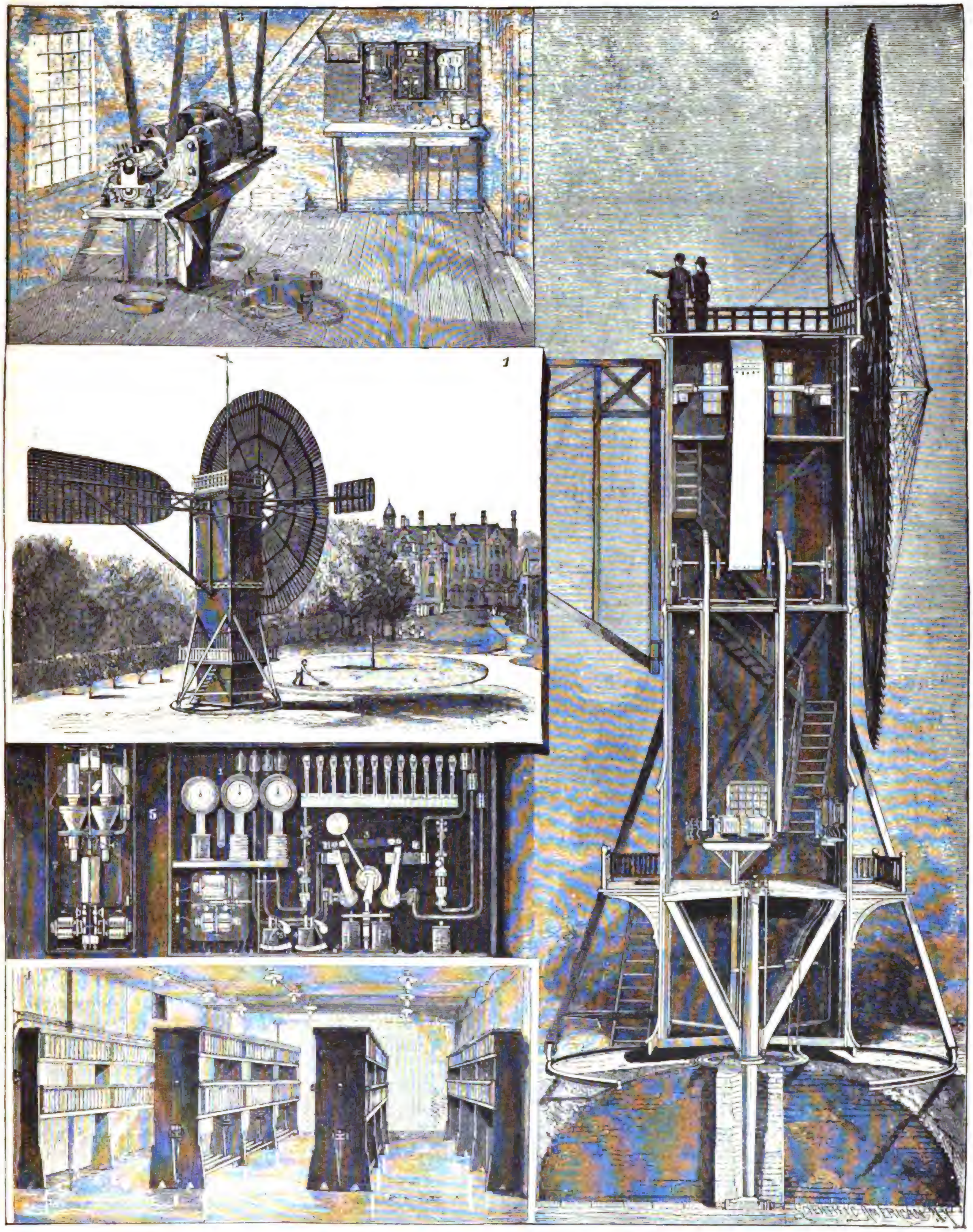
1. *Scientific American.*

THE ELECTRIC LIGHT AS A PROTECTION TO WOMEN.

The city council, of Appleton, Wis., has passed a resolution to the effect that the city in future must be lighted with electricity in place of gas, which is used at present, owing to the fact that so many women are insulted nightly on account of the poorly lighted streets. The city was also authorized to borrow $43,000 with which to carry on the improvements.

POSTAL TELEGRAPHS.

A special dispatch from Washington of December 16 says that the House Committee on Post Offices has resolved to report to the House a resolution setting apart January 6 for the consideration of the Postal Telegraph bill.



WINDMILL AND STORAGE BATTERY ELECTRIC LIGHT AND POWER PLANT OF MR. CHARLES F. BRUSH, AT HIS RESIDENCE, CLEVELAND, O.

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Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

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VOL. X. NEW YORK, DECEMBER 24, 1890. No. 188

Over one hundred men, of the highest ability as original investigators, have toiled an average of ten years each, at the problems of magnetism, thus making an aggregate of one thousand years of successful search in this rich mine of natural truth.—Alfred M. Mayer.

THE HENRY AS THE UNIT OF INDUCTANCE.

IT has often been remarked that modern science is becoming overburdened with units and that in the department of electricity especially this tendency is being carried almost to excess. We think, however, that no one who ponders upon the importance of well established standards and the frequency with which they are used in actual practice as well as in theoretical discussions, can deny their great utility, and, indeed, absolute necessity. The great advances which have been made in alternate current machinery and the studies which are based upon them have long made it desirable to establish a unit of inductance. This was done at the late Paris Congress, but the name selected for the unit, the quadrant, not being in conformity with the general designation of electrical units in which the names of great electricians have been employed, the Henry was very properly suggested and endorsed by the American Institute of Electrical Engineers, and has indeed already been introduced and familiarized by writers on the subject. Having determined upon the adoption of a name it now becomes necessary to establish the value of the working unit, and here, as will readily be seen, a diversity of opinion is liable to occur. The absolute value of the unit of inductance is well determined and defined and can of course not be altered, but in view of the large range of inductance found in apparatus existing in actual practice, there is a question as to the value to be assigned to the most convenient working unit of inductance. The subject has been presented in a masterly manner by Mr. Kennelly in his paper read before the Institute of Electrical Engineers in which he gives a résumé of the history of the unit and to which he adds a large number of examples upon which the selection of a working unit may be based. Mr. Kennelly, it will be noted, inclines to the belief that the thousandth of the earth quadrant or henry would be the most eligible, as being nearest the mean of the values generally found in practice. Whether this value as the working unit be adopted, or not, seems to us of lesser importance than the preservation of the term henry as the unit which is directly related to and derived from the other established units. We may in fact distinguish three classes of units: First, the absolute unit; second, the practical unit; and third, the working unit. In several cases the absolute and practical units now existing coincide in value, but in others they differ and we think that in the case of the henry the same rule ought to be followed that has heretofore been pursued, so that the interdependence of the unit system will remain unbroken and the term henry will always be directly related to the other units. Lapse of time may dictate, as has recently been proposed in the case of the ampere, a change in the value of the working unit, so that if designated by the term, henry, considerable difficulty would be experienced in its adoption, not to speak of the confusion which an old unit and a new unit designated by the same term would bring about. Mr. Kennelly has so clearly stated the case that the discussion which is to follow shortly will, we hope, be as thorough as the present situation permits.

ELECTRO-DEPOSITION OF COPPER.

IN our issue of Nov. 12 we pointed out several errors into which our esteemed contemporary, the London *Electrical Review*, had fallen in its discussion of the economy of the electro-deposition of copper. The points to which we drew attention related solely to matters of practice and of record. As a reply to the errors pointed out by us, our contemporary now refers us to a letter by one of its correspondents, Mr. Desmond G. Fitz-Gerald, which we are told will have the effect of "moderating our transports." We have carefully read Mr. Fitz-Gerald's letter a number of times, but fail to find anything in it controverting the points made by us. That Mr. Fitz-Gerald has thoroughly understood the position taken by us is evident from the fact that he devotes seventeen lines to a categorical statement of the same and then needs nearly two columns to prove that identically the same amount of copper is deposited whether there be employed a current of a large number of amperes at low voltage, or a smaller current at a correspondingly higher voltage. Mr. Fitz-Gerald might have spared himself this trouble, as we fully agree with him on this point, which, indeed, is so obvious that it should require no special or longwinded explanation at this late day. What this has to do with the subject under discussion, however, we fail to see, and hence, if this be our contemporary's reply to our criticisms we must be allowed to consider them as still unanswered. The reference by our contemporary to the similarity of Mr. Stepney Rawson's criticisms to those contained in our editorial remarks we may pass over as beneath notice, unless a pleasantry be intended. If so, we fail to see the joke.

THE POSTAL TELEGRAPH "MOVEMENT."

The movement to place the telegraphs of the country under government control is but another form of the agitation that is intended to place in the hands of municipal bodies the ownership of gas and electric light plants, street car lines, water works and other necessities or conveniences. It is with a recognition of this fact, evidently, that Mr. M. J. Francisco, of the National Electric Light Association, has made an argument at Washington, before the Post Office Committee of the House, in reply to the argument of Postmaster-General Wanamaker favoring a limited postal telegraph service. A copy of Mr. Francisco's address has come into our possession, and we can but congratulate him on the able and effective plea he has made for freedom of private enterprise, basing his argument as he does on fundamental reasons for a broad, comprehensive and clear-cut policy that shall declare itself opposed to government ownership of any undertaking that is essentially commercial in its nature.

Unless we printed the whole of Mr. Francisco's argument, it would be impossible to give all the points he makes against Mr. Wanamaker, they are so numerous and so good, but reference to one or two is in order. Thus, for example, the Postmaster-General has claimed for his "limited" scheme the "strong endorsement of the press of the country." Well, out of 289 articles brought to his notice, no fewer than 209 are for postal telegraphy and 80 are against it! But as Mr. Francisco shows, a great many of the articles are not editorial expressions at all, but are frequently reports, correspondence, or copies of other articles. And then, to delude onesself into the notion that 209 such articles in 144 papers, many of them utterly obscure, represent the "strong endorsement" of the American press!

Mr. Wanamaker stated also that he had received, without any effort on his part, memorials of some twenty-five or thirty boards of trade or chambers of commerce supporting the limited plan. But, as Mr. Francisco shows, this resulted wholly from the work of the New York Board of Trade and Transportation, and, as a matter of fact, the model resolution sent out for adoption was not for the "limited" plan but a committal to the plan of outright government ownership. Here again the paucity of numbers is really striking. This handful of organizations does not represent the sound judgment of the business communities of America. It may be asserted beyond all doubt or fear of contradiction, that the vast majority of the 900 boards of trade and chambers of commerce have not supported the limited plan and would not favor it as a "first step in the right direction" of spending $150,000,000 in the purchase of the telegraphs and telephones of the country.

Mr. Francisco also does a service in bringing forward the utterances of postmasters general who have pronounced against government telegraphs, and in demonstrating how feebly after all the "will of the people has been manifested before Congress in public speech and statement during the last twenty years." The talk about the popular will is absurd. Postal telegraphs are the very last thing one hears talked about by the people.

There has been a little disposition of late years toward the extension of State agency by enthusiastic theoretic people acting, as Herbert Spencer says, "on the tacit assumption that a government moulded by themselves has some efficiency beyond that naturally possessed by a certain group of citizens subsidized by the rest of the citizens," and to which they ascribe marvelous powers for doing multitudinous things quite beyond the reach of the ordinary, unofficial mortal. But, fortunately, there is still, on the other side, a robust belief that officialism is best when at a minimum. The truth is that anything done by the Government is apt to be done more badly and more slowly than if it were done by private individuals directly interested to secure success. Telegraphs would be no exception to the rule. And looking at the wider range of the same principles, applying as they do to electric light plants and electric railways, we are heartily with Mr. Francisco in his campaign against the scheme of the Postmaster-General.

MAGNETO-OPTICAL CURRENTS.

The correlation of the forces of nature is now so well established that the recent note of Prof. Sheldon on the magneto-optic generation of current, effected by reversing Faraday's experiment on the rotation of a beam of polarized light by the current, might well have been accepted as the result of legitimate a priori reasoning sustained by experiment. We must, therefore, confess to some surprise at the negative results obtained and reported in our columns this week by Prof. C. F. Brackett and Mr. S. T. Dodd. It is true that they point out the defects in the methods employed by Prof. Sheldon, due to the presence of electric currents whose influence masked the effects sought for, but we were hardly prepared to learn that their results, when the lime light was employed, were entirely negative. Granting the correctness of the results, one cannot help thinking that *some* effect is produced, but that even our most delicate instruments are not sufficiently sensitive to indicate, let alone measure, it. It is to be hoped that the question here involved will be made the subject of further study and research so that some definite conclusions may be reached.

The Voltmeter as a Testing Instrument.

The drop-in-potential method of testing is so simple that it has become the favorite one in the laboratory for many kinds of electrical testing, but the delicacy required in instruments to ensure accuracy has heretofore largely debarred this excellent method from use in the factory and central station. The Weston voltmeter, which has deservedly won a high reputation for accuracy, makes it possible, however, to perform a number of tests with an accuracy sufficient for all practical purposes and with the most simple auxiliary apparatus, and our readers will therefore be interested in the article by Mr. Osborn P. Loomis, which describes the use of the voltmeter in a number of tests of almost daily occurrence in the workshop and station. For those to whom the use of the reflecting galvanometer presents difficulties, the methods described by Mr. Loomis will prove of much benefit, the great portability of the instrument making it of additional value in out-door work.

INDUCTANCE AND ITS PROPOSED UNIT THE HENRY.[1]

BY A. E. KENNELLY.

PERHAPS the greatest discovery of Faraday's long career of scientific research was that of electro-magnetic induction in the year 1831, when he first brought to light the influence exerted by a magnet or a current upon surrounding matter when subjected to a change of magnetic potential. Oersted had shown that a conductor carrying a current exercised electro-magnetic influence at a distance, and Ampere had ennunciated those simple and beautiful laws this influence is admitted to obey, but Faraday's discovery was a great step; it revealed the action of magnetic force in apparently empty space; it inaugurated that deeper insight into the mechanism, still only dimly guessed, which connects matter with all other matter in space; and it invested the all pervading ether with a dignity and power that in the hands of many great men since his time has probably paved the way for our future comprehension of magnetism, gravitation, and radiant energy, while making the hypothesis of action-at-a-distance a mere mathematical conception and process of thought.

The development of this discovery of electro-magnetic induction has practically created electrical engineering, for it is to machinery operating by electro-magnetic induction that we owe nearly every branch of electrical industry except, perhaps, telegraphy, the forerunner of all; and the condition of modern electrical engineering is such that the units and nomenclature relating to steady currents and permanent magnets is insufficient for practical requirements, and the conditions developed by variable currents and magnets demand the establishment of engineering practical units for the purposes of convenience in expression and computation.

Foremost among these required units is that of inductance, or as it is commonly called the co-efficient of induction. This inductance is a property fully as essential to every electric conducting circuit as resistance and electro-static capacity, and the inductance of a circuit when conveying variable currents is often a far more important factor in regulating the flow than the ohmic resistance. In fact we know that Ohm's law does not apply to a circuit so long as the current is unsteady, unless the inductance of the circuit or the counter electro-motive force it involves be introduced into the expression.

In conformity with the conventional and so-called absolute units of electro-magnetism, an inductance is a length and theoretically can always be computed from the geometrical relations of a circuit; that is to say, if the distance of each point from all other points of a circuit be measured, or inferred, in inches or centimetres, the inductance of the circuit will be some definite number of inches or centimetres, capable of being determined by a possible if not a convenient process of summation. If the circuit, however, be associated with iron or other magnetizable matter, then the magnetic permeability of the environment will enter the terms of summation as a multiplier. In the absolute centimetre-gramme-second system of units, inductance will be necessarily expressed in centimetres, and the centimetre is thus the natural scientific unit, although unsuited to the requirements of electrical engineering.

It may be well to notice that inductance is only conventionally and perhaps not essentially a length. Professor Rücker has pointed out [2]that the multiplication of the permeability factor with the length factor is always tacitly, if not expressly involved, even when the circuit considered is far from magnetizable matter in the ordinary sense; that is to say when residing in a medium of unit permeability, and therefore the nature of inductance is not merely length, but length multiplied by permeability, while physics has not yet decided whether permeability is the simple numerical factor at present assumed, or a function of length, mass and time. Until this question is settled, the real nature of inductance must be considered as doubtful, and the fact that inductance will probably, in any event, be always measured by lengths is no more validly an argument as to its nature, than the usual determination of a body's mass by the earth's gravitational force upon it is an argument that mass is a force. However, the question is one of theory only, and does not affect the consideration of the practical unit.

As has been pointed out by Dr. Sumpner, [3]there are no less than three ways of defining the inductance of a circuit, or a portion of a circuit, and the three definitions are equivalent when the permeability of the magnetic medium is unity, but are not generally equivalent in the opposite event, being then only related in a definite manner by the magnetic properties of the medium. In other words, the inductance of a hollow solenoid of copper wire, placed in a vacuum and far from all iron, has the same numerical value in each of the three definitions, but if an iron core be inserted in it, its inductance will depend upon the definitions elected, and will only be capable of interpretation from its value in one to its values in the others, by taking into account the characteristic permeability curve of the iron, and the conditions of the measurement.

For convenience and general use, however, the secondary definition of Sumpner and Fleming[4] is probably the best to adopt, and valuations in the other two can be reduced if necessary to this when the data for so doing are available.

The inductance of a circuit or portion of a circuit, is then the ratio between the total induction through it to the current producing it. Thus taking a simple helix of five turns carrying a current of two units, and assuming that 1,000 lines of force,[5] passed through the central turn, of which owing to leakage, only 900 thread the next adjacent on each side, and again only 800 through the end turns, there would be 800 + 900 + 1,000 + 900 + 800 or 4,400 linkages of lines with the wire, and this being with 2 units of current there would be 2,200 linkages with unit current, and consequently the self inductance of the helix would be 2,200 centimetres. (Fig. 1.)

The fact that such helices are used in galvanometers, and that the magnetic force at any point within them is admitted to be proportional to the strength of the traversing current, renders it evident that had the current in this case been one unit, 2,200 lines linked with the coil would actually have been produced. Supposing, however, that the helix had been wound upon an iron core, the total number of linkages with the same two units of current would have been greatly increased, perhaps twenty-fold or to 88,000 and the inductance then by the same rule would be 44,000. In this case one unit of current would not in all probability reduce the number of linkages to 44,000, the exact number would

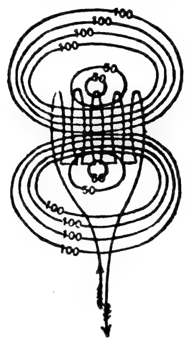


FIG. 1.

depend upon the characteristic curve of the iron core, and the degree of saturation, so that it would now be necessary to state the conditions of the measurement along with the result, in order to convey a clear and definite meaning.

It appears anomalous at first sight to state the above inductances in centimetres when they are derived from the number of lines of force, but it is to be remembered that the total number of linkages is divided in each case not by a mere numeric, but by a current, and this quotient can be proved to be a length in the existing system of dimensions.

In the same way the mutual inductance of two conductors is the ratio of the total induction through one of them to the strength of current in the other producing it. Suppose two coils of copper wire to be held in free space far from iron, and let one of them be traversed by a steady current of say four units. Of all the lines of force issuing from this coil, suppose 500 pass through the other coil. For simplicity, imagine the second or recipient coil to be composed of eight turns so disposed that the 500 lines pass through all in succession. There will then be 4,000 linkages of lines with that coil, and the mutual inductance of the two will be 4,000 ÷ 4 or 1000 centimetres. It is interesting to notice that the same result would be reached if the second coil had the current and the linkages were counted in the first, the pair being mutually conjugate in this respect provided they reside in a medium of constant permeability.

Thus far we have only considered the centimetre or absolute unit, whose unfitness for practical use is evident, since the smallest inductance that is at present known to engineering amounts to several thousand, while the average values met with are counted in millions of centimetres. It would of course be possible to name suitable units from the metrical system of lengths, but it is the proposal of this Institute to adopt the word Henry as the practical unit, in honor of the man, who beyond all doubt, was among the foremost to extend the knowledge thus far possessed of self and mutual inductance.

If the selection of the practical unit were entirely free and subservient only to practical requirements, so that its magnitude should express ordinary values in digits with fewest decimals on

1. A paper read at the 52d Meeting of the American Institute of Electrical Engineers, New York, December 16th, 1890.
2. *Phil. Mag.:* February, 1889. Vth series, Vol. 27, p. 104.
3. *Phil. Mag.:* June, 1888. Vth series, Vol. 25, p. 453.

4. "The Alternate Current Transformer," by J. A. Fleming. Vol. 1, p. 85.
5. The term line of force here is used in the sense of a line of induction; the distinction being necessary when the lines pass through iron.

the one hand, or large numbers on the other, there seems most reason to believe that the thousandth of the earth-quadrant or myriametre would be the most eligible.

Proposed Name.	Length.	Number of Centimetres.	Unit.
Henry	Earth Quadrant.	1,000,000,0000	Practical Unit.
		100,000,000	
		10,000,000	
Millihenry.	Myriametre.	1,000,000	
	Kilometre.	100,000	
	Hectometre.	10,000	
Microhenry.	Decametre.	1,000	
	Metre.	100	
	Decimetre.	10	
	Centimetre.	1	Absolute Unit.

Of course large iron machines employing many turns of wire linked by dense magnetic fields, would have inductances more appropriately expressed in earth quadrants, which might then be termed the kilo-henry just as we now have the watt, and kilowatt, but there is one restriction which makes such a selection undesirable, and that is the hitherto unbroken system of practical units itself. This practical system is a sub scheme of the great international C. G. S. system and especially planned for adaptability to practical requirements. It is derived from that parent system by the substitution for the unit of length, one thousand million centimetres in place of one centimetre, and for the unit of mass an impalpable entity definite only in thought, the one-hundred millionth of a milligramme in place of the gramme. By this substitution in the C. G. S. electromagnetic units, we obtain the hitherto unbroken system of the volt, ohm, ampere, coulomb, joule, watt, and farad. Even these units are not always the most convenient, witness for example the micro-farad in common use, whose prefix is maintained simply in deference to the harmony of the system, for the farad is a capacity that exists only in imagination; the capacity of the earth itself being only about 700 microfarads, and of the sun, or rather a sphere having the apparent dimensions of the sun, being only about 76,000 microfarads. On the other hand a proposition has lately been made to infringe the system by making the volt, the ampere and the watt, ten times their present values, on the ground of practical convenience.[6] However, at the present time, it would surely be unadvisable to attempt the precedent of infringing a system that has hitherto been supported by time, custom, and international Congress.

In this practical system, the unit of inductance must be 1,000 million centimetres. That is an earth-quadrant or the distance from the pole to the equator, measured on the meridian of Paris. Strictly speaking, it is only the quadrant of the French standard earth, which is about one-hundredth of one per cent. shorter than the acknowledged actual earth-quadrant, according to the best determinations, but the fact of the latter being 10,001 kilometres instead of 10,000, is a matter of precision in definition only and in no way affects the practical unit.

As regards the history of the subject, it would appear that prior to 1887, measurements and deductions were confined to scientific works, and were expressed in absolute units—centimetres. In that year—however, a paper was read before the British Institution of Electrical Engineers by Messrs. Ayrton and Perry,[7] who invented and developed a practical measuring instrument for the measurement of inductance, who, aided by Dr. Sumpner, made important contributions to the literature of the subject, and who proposed a name provisionally for the practical unit. That name was the secohm, a contraction of second-ohm, implying the fact that the product of the two was the length equal to the practical unit. They drew attention to the fact that since the Paris Congress of 1884 had fixed the standard legal ohm as the resistance of a column of mercury at zero Centigrade, 106 centimetres long and one square millimetre in cross section, whereas the true ohm was in all probability 106.3 centimetres, or one-quarter of one per cent. greater, the inductances measured in the manner they suggested from seconds and legal ohms, would be in terms not of the standard earth quadrant of 10,000 kilometres, but of legal earth quadrants 9,978 kilometres in length. The difference practically is not very great, but to avoid error or confusion in definition, they advocated provisionally the term secohm, in place of quadrant.

The Paris Congress of 1889 adopted the "quadrant" as the practical unit of inductance defining it as 1,000 million centimetres.

The practical range of inductances is second only to that of resistances, and the latter we know from a few microhms up to thousands of megohms. The smallest inductances are those of Hertz resonators which descend to the order of metres. Excluding these, however, the smallest are perhaps met with in measuring instruments intended to have negligibly small inductance, such as doubly wound resistance coils, Cardew voltmeters, and the like. These descend to the order of decametres, and can generally be expressed as such without prefixing decimal points. It is evident that the term microhenry would suitably apply to their designation. At the other end of the scale we find large induction machines linking dense fields with many turns of wire, and reaching inductances of hundreds or even thousands of henrys. Intermediate between these limits, there exists a large class of circuits having many turns but little iron, or clad in iron with few turns of wire, and these seem to be best expressed by the term millihenry, equivalent to the myriametre.

With the object of setting forth the advantages to be derived from the use of this nomenclature, it may be permissible to adopt it provisionally in describing the measurements that follow. These measurements have been made on different types of apparatus at different times and by different methods, so that they represent mean values from several observations in many cases, but allowance must be made for the variations of standard and type.

In telegraphy, the inductance of an ordinary Western Union 140-ohm relay is about three henrys with the armature drawn well back, and nine henrys with the armature pressed against the poles; in the latter case, of course, the magnetic reluctance of the iron circuit is a minimum, and the same current in the coils causes three times as many lines to circulate through the iron. At the position of the armature in ordinary adjustment the inductance is about five henrys.

The inductance of an ordinary standard 10ω relay is from 200 to 500 millihenrys, according to the position of the armature relatively to the poles.

The inductance of an ordinary sounder is similarly from 25 to 50 millihenrys. These inductances are the values obtained with only a few milliamperes through the coils, and since the path of the induction is largely through iron, the inductance varies with the strength of the current used. Practically, however, the variation is small within the range of current at which instruments usually operate.

SUBMARINE TELEGRAPHY.

The inductance of a mirror speaking galvanometer of the ordinary type having 2,250 ohms was found to be 3.6 henrys.

TELEPHONY.

The inductances met with in the ordinary long distance telephone apparatus are as follows:

The call bell 80 ohms and 1.4 henrys.

The magneto armature 550 ohms, and from 2.7 henrys with the plane of the coil in the line joining the poles, to 7.3 henrys when the iron core joins the poles, the plane of the coil being then at right angles to the magnetic flux.

The induction coil primary 0.28 ohm and 3.5 millihenrys.

Secondary 164 ohms, and 734 millihenrys.

The mutual inductance between the coils 60 millihenrys.

The Bell telephone receiver 75 ohms and from 75 to 100 millihenrys. The removal of the diaphragm from an ordinary telephone of this type reduces the inductance about 35 per cent. All these inductances are due to currents of a few milliamperes only. As regards the inductance of aerial line wires, it is to be regretted that measurements are not yet forthcoming, and indeed the experimental determination is attended with some difficulty, owing to static capacity and imperfect insulation. In the absence of direct measurements, theory indicates that the inductance of overhead copper wires depends upon the elevation above the ground as well as upon the diameter. In the case of iron wires as used in telegraphy, the permeability of the iron enters as an additional factor. The following table of inductances for copper wires, is based upon a formula first given by Clerk Maxwell.[9] It is to be hoped that experimental evidence may shortly be collected corroborating these results:

The inductance of iron wires, in the absence of measurements, is almost too doubtful to justify calculation, being perhaps 10 times more than the inductance of copper wires under similar conditions. The difficulty in their case lies in assigning the proper value of permeability.

ELECTRIC LIGHT AND POWER.

Dynamos and dynamo-electric machinery are of course generally characterized by large inductances.

The inductance of the field magnets of a dynamo may have any value depending on the size and voltage of the machine from one henry up to 900 henrys.

The inductance of an armature may similarly vary from 20 millihenrys up to 50 henrys between brushes. One millihenry is a fair average value of the inductance of one section of an armature. Armature inductances depend not only on the strength of the measuring current, but also upon the strength of the field, and whatever influences the permeability of the core.

The inductance of an alternating transformer varies from a primary of 400 millihenrys, a secondary of one millihenry and mutually 20 millihenrys with a transformation ratio of 20, up to corresponding values perhaps 100 times as great.

6. *The Electrician* of London, Sept. 19th, 1890, p. 558, Report of British Association Discussion.

7. Journal of the Institute of Electrical Engineers, London, April, 1887, Vol. XVI., p. 291.

9. Clerk Maxwell, "Electricity and Magnetism," 2nd Edition, Vol. I. p. 293.

TABLE OF INDUCTANCES OF COPPER ÆRIAL LINE WIRE, PER KILOMETRE AND MILE, FOR DIFFERENT DIAMETERS, AND ELEVATIONS ABOVE THE GROUND.

Diameter of wire.		Elevation above ground 400 cms. or 13.1 ft.		Elevation above ground 700 cms. or 23 ft.		Elevation above ground 1000 cms. or 32.8 ft.		Elevation above ground 1300 cms. or 42.7 ft.	
		Millihenrys or Myriametres.		Millihenrys or Myriametres.		Millihenrys or Myriametres.		Millihenrys or Myriametres.	
Centremetre.	Inches.	per Kilo-metre.	per Mile.	per Kilo-metre.	per Mile.	per Kilo-metre.	per Mile.	per Kilo-metre.	per Mile.
0.10	0.039	1.986	3.196	2.109	3.393	2.170	3.493	2.242	3.576
0.20	0.079	1.848	2.974	1.960	3.154	2 031	3.268	2.083	3.352
0.30	0.118	1.766	2.842	1.878	3 022	1 950	3.138	2.002	3.222
0.40	0.158	1 709	2.750	1.821	2.930	1.892	3.045	1.945	3.130
0.50	0.197	1.664	2.678	1.776	2.858	1.847	2.973	1.900	3.058
0.60	0.236	1.628	2.621	1.740	2.800	1.811	2.914	1.863	2.998
0.70	0.276	1.596	2.569	1.709	2.750	1,780	2.865	1.833	2.950
0.80	0.315	1.570	2.527	1.682	2.706	1.754	2.823	1.806	2.906
0.90	0.354	1.547	2.489	1.659	2.669	1.730	2.785	1.783	2.870
1.00	0.394	1.526	2.456	1 638	2.635	1.709	2.750	1.761	2.834

APPARATUS. THE INDUCTANCE OF RUHMKORFF COILS.

The smallest medical coil in ordinary use has five millihenrys in its primary, 100 millihenrys in its secondary, and 20 millihenrys mutually between them.

A large induction coil 19 inches long and eight inches in diameter has 0.145 ohms and 13 millihenrys in its primary, 30,600 ohms and 2,000 henrys (by two concordant methods of measurement) in its secondary, and 163 henrys mutually between them.

The inductance of a mirror galvanometer may vary from a few millihenrys up to 10 or more henrys according to its resistance. Two henrys is a fair average for an astatic mirror galvanometer of 5,000 ohms.

An ordinary electric bell of 2.5 ohms resistance was found to have an inductance of 12 millihenrys.

There is one point in connection with the self and mutual inductance of induction coils and transformers, that deserves attention owing to the confusion that occasionally arises concerning it. It may be, perhaps, best represented by a numerical example. Let a closed Faraday ring of iron 100 centimetres in mean circumference and 20 square centimetres in uniform cross section, be closely wound with a primary coil of 2,500 turns in one layer, followed by a secondary coil of 7,500 turns also in one layer. If now two amperes be maintained steadily through the primary, the magnetic force in the iron will be $4\pi/10$ times the ampere-turns per centimetre of the iron circuit or $4\pi/10 \times 2 \times 2{,}500 \div 100$ or 62.85. The permeability of wrought iron at this force being, say 250, the induction developed per square centimetre will be 250×62.85 or 15,713 lines, and the total induction enclosed by the primary coil, neglecting the space occupied by the wire itself will be $20 \times 15{,}713$ or 314,250 lines which traverse every turn of both windings. The linkages with the primary will be $2{,}500 \times 314{,}250$, or in round numbers 786,000,000 and referred to one absolute unit of current (ten amperes), five times this number, or an inductance of 3,930 million centimetres, that is, 3.93 henrys. Similarly the linkages of these lines with the secondary will be 2,358 millions, and for ten amperes of primary current 11,790 millions of centimetres mutual inductance or 11.79 henrys. Next suppose the primary current interrupted, and a current steadily established in the secondary sufficient to produce the same magnetic force in the iron, thus avoiding the complication of a changing permeability. As the secondary has three times as many turns, the current effecting this will be two-thirds of one ampere. The total induction through the iron will now be the same as before and therefore the linkages will be equally numerous. The self inductance of the secondary will be $2{,}358{,}000{,}000 \div \frac{1}{15}$, or 35,370,000,000 centimetres, that is, 35.37 henrys. The mutual inductance will similarly be $786{,}000{,}000 \div \frac{1}{15}$, or 11.79 henrys, as before. It will be found on carrying the reckoning to the necessary degree of accuracy, that this mutual induction 11.79 is the square root of the product of the two self-inductances, 3.93×35.37.

Examination of the steps in this calculation will show that this proposition must hold for all closed magnetic circuits uniformly magnetized to the same degree when the space occupied by the windings is not taken into account. Under the opposite conditions of open and especially of short iron cores, with large winding spaces, the condition usually fails, and the mutual inductance may be greater or less than the square root of the self-inductances multiplied together.

Another reason in favor of selecting 1,000 million centimetres as the value of the practical unit or Henry, is the desirability of having the time-constant of an electromagnetic circuit expressed directly in seconds by its practical units as in the case of electrostatic circuits, rather than revert to a unit of inductance that would yield the time constant in milliseconds or other fractional period of time. The time-constant of a simple electromagnetic circuit, a circuit having inductance and resistance but negligibly small electrostatic capacity, is defined as the ratio of its inductance to its resistance, that is, of its henrys to its ohms. It is an important function, and its consideration presents some remarkable analogies between inductance and electrostatic capacity that it is interesting to trace.

Imagine an inductance coil C without iron to be supplied with a steady current from an electromotive force E of 50 volts. Let the inductance of the coil be three henrys, and its resistance 10 ohms. (Fig. 2.) Ohm's law determines the strength of the current to be five amperes. Now short circuit the terminals of the coil very suddenly by a wire across its terminals of negligible resistance. The current in the coil C does not stop instantly, but under the name of extra current is maintained in the coil by reason of its inductance. According to theory, the last dregs of the current will never entirely vanish from the coil, although after the first few seconds the remainder is exceedingly small. The very first instant after short circuiting, the current continues at five amperes by its electro-magnetic momentum, but being unsupported, its energy is lost thermally in overcoming the coil's resistance, and it immediately falls. In falling, the lines of force linked with the circuit and sustained by the current, are drawn in, cutting the coil as they recede, thus creating a counter E. M. F. tending to prolong the current, and this process of dwindling current with reduction of opposition from the reserve of inductance, descend together. The total quantity of electricity that will flow through the circuit under the conditions specified, may fairly be called the charge or discharge of the coil, and it can be readily proved that this charge is equal to the quantity that would be conveyed by the initial discharging current, acting uniformly during a time equal to the time-constant of the circuit. In this case the discharge commenced at five amperes, and the time-constant is 0.3 se ond, so that the total discharge will be that due to the flow of this current in 0.3 seconds, that is 1.5 coulombs.

To represent the case graphically, suppose the curve of discharge in time to be plotted as in the figure. Let the axis OX be divided off into seconds, and the axis OY into amperes. (Fig. 3.) The discharge commences at five amperes, subsides rapidly at first, but at last so slowly that an indefinitely long time must elapse before it altogether disappears. The area enclosed between the curve and the axis represents ampere-seconds or coulombs to the amount of the total charge, and the proposition just stated asserts that if the current had continued at five amperes steadily for 0.3 seconds, the area of the dotted rectangle so generated YDTO would be equal to the total area enclosed between the curves and the axes prolonged to the ultimate point of union.

Curiously enough, exactly the same law applies to the discharge of a condenser through a circuit of resistance but negligibly small inductance. The time-constant of the circuit in this case, however, being its capacity in farads multiplied by its resistance in ohms.

The curve of discharge is of the same type for inductances or capacities. It is logarithmic, and finds its prototype in the case of the discharge of water in time, from a tank having a faucet at the base, assuming that the rate of escape through the faucet at any moment is directly proportional to the pressure, or level of water then remaining in the tank.

The laws which control the outline of this discharge curve are identical for condensers or short circuited inductances, and are combined in the following enunciation:

The natural logarithm of the ratio of the $\left\{\begin{matrix}\text{full charge}\\ \text{initial current}\end{matrix}\right\}$ to the $\left\{\begin{matrix}\text{residual charge}\\ \text{discharging current}\end{matrix}\right\}$ at any instant is the quotient of the time during which discharge has been in progress by the time constant of the circuit.

In this statement two reservations are necessary.

The electrostatic circuit must be free from all appreciable inductance, and the electro-magnetic circuit must contain negligibly small electrostatic capacity. It was first pointed out by Sir William Thomson that the discharge of a condenser through an inductance circuit, becomes oscillatory when the inductance exceeds a certain critical value.

When an inductance discharges through a break instead of a closed circuit, the conditions become complicated to a degree that eludes complete practical solution in the present state of knowledge.

At the period of natural discharge equal to the time constant, an inductance or capacity charge or current will have fallen to 36.8 per cent. of its initial value.

Similar propositions relate to the charging currents and quan-

tities. In the above instance, after the coil has completely discharged, remove the short circuiting wire. The current will immediately enter the coil, and the curve of its arrival in time is represented in Fig. 4, this curve being only an inversion of the preceding. For this reason it is evident that the area above the curve now represents the charge, and by an extension of meaning, the deficit from full current, such as BC, may be called the charging current, since on discharge and reversal of the diagram, this will be the discharging current at the same lapse of time. In fact, the current AC is doing work in heating the coil, the deficit from ultimate current BC being only active in increasing the electro-magnetic momentum of the circuit, and work is really stored in the coil as though the deficit current did exist. A similar but inverted curve of current in time represents the charge of a condenser. In each case and under the above restrictions the following propositions hold:

The natural logarithm of the ratio of the $\left\{\begin{matrix}\text{full charge}\\ \text{initial current}\end{matrix}\right\}$ to the $\left\{\begin{matrix}\text{deficit from full charge}\\ \text{charging current}\end{matrix}\right\}$ at any instant is the quotient of the time during which the charge has been in progress by the time constant of the circuit.

When the charging interval reaches the time constant, the charge will have attained 63.2 per cent. of its full value.

Another relation between simple electrostatic or electro-magnetic circuits and their time-constants is in their stores of energy. The energy of the charge in each case is half the energy that would be developed by the initial charging or discharging current against the ohmic resistance of the circuit in the time equal to the time-constant. In the above instance for example, five amperes being the initial charging or discharging current, and

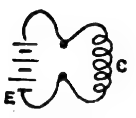


Fig. 2

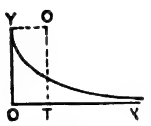


Fig. 3

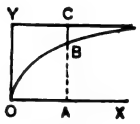


Fig. 4

the resistance 10 ohms, the circuit energy of this current per second would be $5\times5\times10=250$ joules, and during half the time-constant the energy thus developed would amount to $0.3\times250\div2$ or 37.5 joules. This is the electro-magnetic energy stored up in the charge.

These are not the only analogies that exists between inductance and capacity, but there are remarkable points of diversity. The discharge of extra current of a coil is in the same direction as the circuit current, with the condenser it is the reverse. In a great many practical instances, the electro-magnet and the condenser are used to annul each other's influence.

The time-constant of an inductance circuit is generally small for the reason that a coil of large inductance has generally many turns and therefore high resistance, so that the ultimate ratio of the henrys to the ohms is not large. For example, the time-constant of a Bell telephone, considered in itself or on short circuit, is from the measurement above described, about $0.09\div75$ or 0.0012 seconds, and therefore a steady E. M. F. of, say, two volts, impressed directly upon such a telephone would produce in this interval of time 63.2% of 2/75 amperes, namely, 169 milliamperes. By adding inductanceless resistance to the circuit, however, and raising the E. M. F. proportionately, the time-constant would be lessened, and the arrival of current accelerated. Strictly speaking this reasoning is inaccurate, since the telephone coil surrounds iron, but with the small currents usually employed, the iron probably does not greatly influence the arrival curve. In the case of dynamo field-magnets, and large ironclad inductances generally, the divergence of the arrival curve from that of a corresponding simple electro-magnetic circuit is considerable.

There are several methods by which self and mutual inductance can be measured, the selection depending on the magnitude to be determined and its nature. The Ayrton and Perry secohmmeter or double revolving commutator is perhaps the most generally useful. It may be employed in connection with a standard condenser, a standard inductance, or apparent change of resistance with speed. Being used in the Wheatstone bridge, the currents it can alternate are necessarily limited in strength.

For small inductances,[10] say, less than one-tenth of a millihenry, the method of Professor Hughes[11] or its modification by Lord Rayleigh is probably best suited, using two coils of mutual inductance and a telephone as the observing instrument.

The inductance coils are usually in the form of two concentric rings, the inner being capable of rotation about the common vertical. The mutual inductance of such a pair of coils is a complex function of the dimensions and the angles between the planes at which the coils may be set. It is usual to calibrate the instrument by separate measurements of the inductance at different angles. A simpler arrangement however, for mutual inductance is a short solenoid in the bridge circuit superposed coaxially upon a long solenoid in the battery circuit. Adjustment to silence in the telephone for interrupted currents is then made by including in the bridge circuit a greater or less number of turns in the outer solenoid. The mutual induction is then very nearly proportional to the number of turns so included, and by suitable proportions in construction, the accuracy can be carried as far as the telephone for the receiver will permit.

For the measurements of inductance in coils on iron machinery, the ballistic galvanometer is frequently employed, either by the method of discharge for self inductances, or induced quantity with mutual inductances. Mutual inductances connected by closed iron circuits present no difficulty when great accuracy is not required, since, as already observed, the self inductances are calculable in these cases when the mutual inductance and the number of turns in the coils are known. It is much more difficult, however, to measure the self-inductance of the field-magnet of a dynamo when the armature is removed, and when currents of the normal exciting strength are used in the measurement. The best attempt has been made apparently by observing the discharge effects of gradual small changes of a strong current passing through the coil, in circuit with a specially arranged Wheatstone bridge.[12] If it were of sufficient practical importance, however, to measure such inductances with powerful currents, a recording instrument might be tried, having a very light and swiftly moving pointer, leaving a trace of its motion on a strip of moving paper like Sir William Thomson's siphon recorder. If such a pointer was arranged to give an amplitude of movement at right angles to the paper strip, in proportion to the current traversing the coil, it would register the curve of discharge when the coil was short-circuited, in the manner described above. On a sufficiently enlarged scale, corrected perhaps for residual inertia in the moving parts, this curve would give not only the total quantity of discharge, but its deviation from the logarithmic line of simple electro-magnetic discharge, would give the means of determining the characteristic of magnetization in the iron.

Of far lesser importance than the selection of the practical inductance unit, but still well worthy of separate consideration is the selection of appropriate symbols to represent the unit briefly. It might perhaps be advantageous to represent the henry by a capital H., and the millihenry by the plain letter h. This notation would enable such an inductance as 50 henrys to be written as 50 H, and 50 millihenry as 50 h. The microhenry occurs so seldom that it would probably not need a symbol.

All measurements of precision should employ true ohms and not legal ohms in the computations. The best existing value of the true ohm is 1.0028 legal ohms.[13]

The correction is practically so small that it can best be carried out by altering the nominal standard temperature of the resistance coils adopted. These temperatures should be increased by 9.4°C for platinum-silver, 6.5°C for German-silver, and 13.5°C for platinoid. Thus a resistance box with platinum coils standardized for legal ohms (of 106.0 cms.) at 15°C would give true ohms of 106.3 cms. at 24.4°C as the best approximation, and this would be the standard temperature of the box for use in precise measurements of inductance.

STORAGE CARS FOR WASHINGTON.

It has been definitely determined by the Metropolitan Street Railroad Co., of Washington, to change its motive power from horses to electricity, and the storage battery system has been adopted, Mr. C. O. Mailloux, the well-known electrical engineer, being engaged to carry out the work and to embody all possible improvements in methods of construction and operation. Mr. Mailloux has already had a storage car running with much success over the company's lines, and now has the task of getting 40 cars ready for service, with full equipment. The company voted on Dec. 11 to increase its capital stock $500,000 to carry out the change, and will proceed to build two power houses, for one of which, to run the F street line, property has just been secured. All the cars will be new, and all the tracks, too, 60lb. grooved rail being now in course of laying. The directors of the Metropolitan Railroad Company, upon whom will devolve the execution of this plan that means so much for the cause of rapid transit in Washington, are Messrs. George W. Pearson, president; A. A. Wilson, vice-president, and Dr. Daniel B. Clark, John Cammack, A. A. Thomas, Robert Beall, and Robert D. Weaver.

MR. W. F. SHERMAN.—The death is announced at Lowell of the above-named inventor, who was greatly interested in questions and problems of rapid transit.

10. *Journal of Institution of Electrical Engineers, London Journal, Jan.* 1886.

11. For another method of measuring small inductances with an alternating current, see an article by C. Steinmetz in *The Electrical Engineer*, Vol. x. Nos. 130, 131. Nov. 1890.

12. Phil. Mag.: Feb. 1889. Dr. Sumpner.

13. Report of the Committee on Electrical Standards read before the British Association, Sept. 1890. See the London *Electrician* of Sept. 26th, 1890.

EUROPEAN CORRESPONDENCE.

LONDON.

Electric Lighting of a Thread Factory.—Meetings of Companies.—Telephones.—Trial of Electric Meters.—Paris Companies.—Watt vs. Maxim Weston.—Paper on Electric Lighting Progress.—Tramways.

THE whole of the immense buildings used by Messrs. Barbour & Co., Hilden, Ireland, for the manufacture of thread have been fitted throughout with electric light. As showing the gigantic scale of this concern, one may mention that the buildings occupy a space of thirty-five acres, and over 5,000 workers are employed.

The meetings of electrical companies have been numerous during the past few days. Fowler Waring Cables shareholders dropped in to ascertain the date of probable dividends. The chairman met them with statements of delays (not specified), which were now overcome, a good factory had been secured, an able manager was running it and the directors expected from that day there would be nothing but plain sailing. It is a remarkable fact that the position of a company looks brighter and sounder on the day of the annual meeting than at any other period subsequent or previous.

The Electric Construction Corporation held its first annual meeting on Monday. The chairman, Sir H. Mance, remarked that the company possessed patents of undoubted value, which although undeveloped, would in the hands of subsidiary companies now formed, prove a solid source of income. Upon paper their transactions looked very flourishing indeed, but he hoped shareholders would support the policy of the directorate in the decision not to apply any profits of the sales of patents to the credit account, until the patents had been written off. They were carrying on at Wolverhampton and Millwall continuous experiments. A notable one was the extraction of phosphorus by means of electricity. In view of the progress of electric lighting in England and probable contracts, it was decided in order to secure increased business to make an issue of £100,000 of debentures bearing six per cent.

Reuter's Telegram Company are taking advantage of that clause of articles of association which enables any commercial undertaking to make money out of work as widely different as the supply of public electric lighting and the washing of private linen. It is intended to take up an international advertising agency by means of their cables.

The National Telephone Company will pay in a few days a dividend of five per cent., which is the last before the expiring of the patents held by them with peculiar injudiciousness for a good many years. During this period the bearing towards customers has slowly if silently created a host of enemies whose ill feeling and bitterness will act with great influence on future developments of this concern. Their position is analogous to that of King John, and the charter of liberty for the users of the telephone may be said to date from July of 1891. In answering a question in the House of Commons, on Monday, with reference to the telephones, Mr. Raikes, the Postmaster-General, expressed a hope that he would be able before long to announce the decision of the Government with regard to licenses for telephone exchanges.

Last year a trial of electric meters took place in the city of Paris, which was postponed to this year. There are now fifty sets of apparatus which are to compete for the first place. The jury selected to examine the instruments will be composed of nine members, of whom five are chosen by the Municipal Council.

Parisian electric lighting companies which recently obtained concessions for 18 years are anxious to prolong the period to 1930, and as an inducement offer to lower the price charged for current.

Watt *vs.* Maxim-Weston Electric Co. is no new feature in the English law courts. This is the *Watt* which the unfortunate company could not manage with any degree of success, and dispensing with his services, actions were brought against them for monies due for salary, damages, wrongful dismissal, etc. Any one acquainted with the sad history of the Maxim Weston patents in England, cannot fail to see that many of its misfortunes were due to the connection with Watt. It marks an epoch in the records of gross mismanagement, and strong opinions have been given from the judicial bench on this subject. What appears to be the final action has been concluded; the case was three days in the courts, at the end of which the judge suggested that some arrangement should be made. The counsel met in consultation and agreed to compromise the matter. Thus ends the last act of drama of the Maxim-Weston Co., which has lived for no one's benefit save the lawyers'.

To-night a paper will be read before the Society of Arts on "Electric Lighting Progress in London," by Mr. F. Bailey, engineer to the Metropolitan Electric Supply Co. The paper will no doubt be most interesting, as the lecturer's position enables him to deal with the subject in a trustworthy manner.

The North Metropolitan Tramways Co. have received the consent of the County Council to run electric cars over the northern portion of its line controlled by the Council for a term of seven years. The Tramway Co. has also given notice of a bill which it intends to introduce into Parliament asking that the local authority be compelled to conform to the Act passed last session giving tramway companies a full term of seven years guaranteed by the Act. At present the West Ham local authorities decline to grant more than one year's license subject to twenty-four hours' notice.

The General Electric Power and Traction Co. are offering to the tramway companies to supply cars and the electrical equipment and to maintain the motors, switches, gearing and accumulators at a mileage rate, the tramway company operating the road at their own expense.

H. S.

LONDON, Dec. 10, 1890.

CORRESPONDENCE.

CHICAGO.

Evanston Objects to Telephone Wires.—A Street Railway for Tolleston.—A Big New Apartment Building.—Electric Club Dancing Parties.

AT the village board meeting at Evanston, last week, the Chicago Telephone Co. was charged with erecting poles on Ashbury avenue, without the knowledge of the board and an order has been served upon it forbidding all further work of extension in the village until the poles are removed to some more suitable route to be designated by the board.

The Board of County Commissioners of Lake County, Indiana, at its December session, granted a right of way over the highways between Crown Point and Tolleston to the Crown Point and Indiana Stock Yarks Street Railway Co. The company, composed of Crown Point capitalists, headed by W. C. Murphy, proposes to build an electric street railway line directly north from Crown Point along the section line road to Tolleston, and on to the town to be established by the packers. This line when finished will be about one and nine-tenths miles in length.

A large apartment building is to be erected on the northwest corner of Cottage Grove avenue and Fortieth street, at a cost of $225,000. It is to be seven stories high, with steam, electric light throughout and elevator service.

The first of a series of informal dancing parties to be given by the Chicago Electric Club, will take place December 26th, 1890, commencing at 8 o'clock. The club rooms will be used for the purpose of reception and cloak rooms, while as the committee, in their circular, naively put it "the light fantastic will be tripped in the most approved electric club manner to the music of Pound's full orchestra in Kinsley's Banquet Hall." It is hoped that every member will attend and bring his friends, thus maintaining the recognized social and hospitable standing of the club.

CHICAGO, Dec. 20, 1890.

BOSTON.

Fire Department Wires.—Lighting Up a Store Front.—New England Printing Tel. Co.—West End Power Station.

INSPECTOR OF WIRES FLANDERS has commenced operations by making a number of changes in the fire alarm department.

It is estimated that there are over 5,000 miles of overhead wires it this city, 525 miles of which belong to the fire alarm department. Of this amount of wires a large percentage is known as "dead wires," and Supt. Flanders will at once begin the work of removal.

The fire alarm system of Boston was the joint invention of Dr. W. F. Channing and Prof. M. G. Farmer, both of whom are now living. The system was put in operation April 28, 1852, and was the first electric fire alarm system in the world.

Messrs. Houghton & Dutton, one of the enterprising dry goods firms of this city, have made a very striking display of electric lights on their store as a Christmas greeting.

Both the Tremont street and the Beacon street sides of the structure were hung from top to bottom with three rows of red electric lamps, while in the centre the device gleamed forth in large letters:

HOUGHTON
and
DUTTON.
MERRY
CHRISTMAS.

No less than 530 electric lights were used in making the mammoth display.

The New England Printing Telegraph Company has completed its line from Providence to Boston, and will soon be ready to do

business between these two cities. The line also communicates with Woonsocket, R. I., and Pawtucket, R. I. The writer had the pleasure this week of sending an important message from Providence to Boston, which was speedily and expeditiously attended to.

The West End Street Railway Co. are rapidly pushing ahead with their power station, and have nearly ready for use two batteries of boilers. The foundations for the temporary engines and generators to be placed in the boiler house are almost ready and preparations are being made for their reception.

The 252 feet chimney stack is now complete and rears its head proudly over anything in Boston, and this week one of the lightning rods was safely attached to its side. The writer had the pleasure one day this week, of ascending to the top, whence a magnificent view of the surrounding country can be had. The inside diameter at the top is thirteen feet, and it is difficult to imagine, when one is walking around the platform on top, that such a large aperture is necessary, and that one is on the top of a chimney stack. The new Robinson radial cars are commencing to arrive now, and inside of a month or two there will be about fifty of these in service. Work is being actively pushed on the plans for the elevated road, though no decision has yet been arrived at as to the actual route through the city, permission not having yet been granted for the Harrison avenue extension.

BOSTON, Dec. 19, 1890.

PITTSBURGH.

The Great Snowstorm.—Affairs of the McKeesport Light Co.—Local Light Companies Are Not Manufacturing Concerns.

PITTSBURGH has been visited by a terrific snowstorm, and since last Wednesday the streets have been almost impassable. The Signal Service officers stated that this city never had a snowstorm like it in severity and it may be easily imagined, that the effects it had were considerably damaging. In this respect it is certain that nothing suffered so much as the electric wires. According to the latest estimates the Western Union Telegraph Co. and the District Telephone Co. alone had their systems damaged to the extent of $50,000. It is therefore safe to presume that the electric light, the electric street railway and the cable companies were also heavy losers on account of the storm. There fell altogether 26 inches of snow within 24 hours. The telegraph, telephone, electric light and electric street railway wires were covered with snow until the load often became too heavy and they snapped. In many instances where the wires did not break, the poles gave way under the heavy weight of snow and wires. The result throughout the city presented on Wednesday a complete scene of demoralization as far as wires were concerned. In several portions of the city the light wires were damaged and in the evening the streets were dark. The "Hello" through the telephone was a futile attempt, because "Central" could not receive. Owing to the snow and slush in the streets as well as the condition of the wires the electric roads had to suspend business altogether for the greater part of last Wednesday. But the cable and the horse cars could not be operated either, because the streets were impassable to any vehicle. A number of accidents were also caused by the broken wires, but considering the enormity of the damage done accidents were very few. Two horses were killed by a current from a street car wire and the driver was knocked off his seat, but that was about all that happened. Out of 3,500 telephone wires 1,000 were broken down. The repairs are estimated to cost $25,000.

Judge Ewing, of this city, yesterday refused the mandamus asked for by Thomas A. Edison and others of the McKeesport Light Co. against a minority of stockholders, who prevented the election of officers. The judge thought the minority should not rule, but he held that the application of the plaintiffs was not properly presented and he therefore refused to grant the mandamus.

In the case of the Commonwealth of Pennsylvania *vs.* the Brush Electric Light Co., of Philadelphia, Judge Simonton at Harrisburg, yesterday banded down an opinion, holding that the electric light companies are not manufacturing corporations, and consequently are taxable on their capital stock. The defendant company claimed that it was not only a manufacturing corporation, but that the general revenue act of 1889 was unconstitutional, because it lacked equality and uniformity. Judge Simonton also decided the latter part in favor of the Commonwealth, thus affirming the constitutionality of the tax on capital stock, which amounted last year to nearly one million dollars, all of which would appear to have been illegally collected had this decision been otherwise. The case will be appealed to the Supreme Court.

PITTSBURGH, Dec. 19, 1890.

COLLEGE NOTES.

DEPARTMENT OF ELECTRICAL ENGINEERING—PRINCETON COLLEGE.

We have received an advance proof of a very pretty and neat little pamphlet setting forth the electrical course at Princeton and the various agencies and apparatus provided there for students in electrical engineering. It is illustrated by photogravures of the Observatory Building, the Main Laboratory, the Reading Room, the Dynamo Building, and the Engine Room, the pictures being excellent. The facilities for experimental work are evidently abundant.

The course in electrical engineering at Princeton occupies two years, and the John C. Green School of Science furnishes a course in mathematics, physics and modern languages, which is especially arranged to meet the requirements for entrance on the electrical course. The requirements for entrance are the same as those of the Department of Civil Engineering, which is completed at the end of the third year. Applicants who have not taken this course are not admitted unless they give evidence of suitable preparation in mathematics, physics and general chemistry, these studies being considered essential preliminaries. If the applicant is deficient in analytical mechanics, drawing, or modern languages, an opportunity will be given him to take suitable courses in those studies in the School of Science.

THE PRATT INSTITUTE, BROOKLYN.

The first term of the course of lectures and experimental work given to the class in electrical construction of the Pratt Institute, Brooklyn, ends on December 19.

The work in the department has been carefully planned with the view of giving the students, first, a theoretical knowledge of the principles of electricity, and then tracing the practical application of these principles to the various branches of electrical engineering and construction.

The class is mainly composed of young men employed in various electrical industries, who have availed themselves of an opportunity to better their education in the electrical field while still attending to their daily duties. The general supervision of the class is under Mr. C. R. Richards, Director of the Mechanic Arts Department of the Pratt Institute, while the students are under the immediate care of Mr. F. W. Dunbar, graduate of the Massachusetts Institute of Technology.

The first term's lectures have consisted principally in a drill of the fundamental laws of the electric current and magnetism, leading up to the application of the electro-magnet to the dynamo. Tables of specific resistances, primary battery E. M. F's. and resistances, etc. have been furnished to the class in a form the most convenient for practical use, and the essential laws and formulæ of electro magnets presented as clearly as possible. Attempt has been made to keep up to the present times in both the theory and practice of electricity.

The laboratory work has consisted in a personal demonstration by each student of the laws stated in the lecture room, including the laws of permanent and electro-magnets, relations of current, electromotive force and resistances, and a thorough drill on the Wheatstone bridge. Each student keeps the results of his own experiments carefully written in his note book, which is subject to the inspection and criticism of the head of the department. Power and battery current are available for use in both laboraratory and lecture room.

The second term, beginning January 5, 1891, will be occupied with the practice and application of power electricity, including incandescent and arc lighting, stationary motor and tramway work and transmission of power. Considerable time will also be spent in a practical course on telegraphy and telephony.

A direct current motor and dynamo and alternating dynamo will be used in the laboratory for experimental work by students during the coming term, and every possible facility given to the young men to broaden their practical knowledge of modern electrical construction.

ELECTRICAL LECTURES AT COLUMBIA COLLEGE.

The following course of evening lectures on "Practical Electricity," fully illustrated by experiments, will be given at Columbia College, by Francis B. Crocker, E. M., and Michael Pupin, Ph. D., the instructors in electrical engineering, on successive Thursdays, at 8 o'clock, commencing Jan. 15, 1891.

1. General Principles of Electricity, showing principal ways of producing it and effects produced by it.
2. Electro-magnetism.
3. Electrical Units and ways of measuring electricity.
4. Dynamo-electric Machines.
5. Electric Motors and transmission of power.
6. Electric Lamps.
7. Alternating Current Electricity.

8. The Telegraph.
9. The Telephone.
10. Storage Batteries.

These lectures are intended to give a reasonably intelligent idea to professional and busines men of the most important practical applications of electricity.

The fee for the course has been fixed at $10 payable in advance. Persons desiring to avail of this opportunity must register their names in the president's office on or before January 10, 1891, and pay the fee at the time of registration.

Should the number of applicants exceed the accommodations of the lecture room, preference will be given to those who register earliest. Tickets will not be issued to a greater number than can be accommodated with seats. It will not be possible to obtain admission to single lectures or to a part of the course at a reduced fee.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The fifty-second meeting of the American Institute of Electrical Engineers, was held at the house, 12 West 31st street, on December 16, the attendance being very large. The "Henry" committee reported in favor of keeping the new unit as the equivalent of the "quadrant." Mr. A. E. Kennelly read the paper printed elsewhere in this issue on "Inductance and Its Proposed Unit the Henry." Discussion on both report and paper was postponed until the meeting of January 20, 1891. Mr. Emile Berliner, the inventor of the machine, then read a paper on the gramophone, accompanied by a full programme of musical and other records made by the gramophone. A record was also taken and etched in sight of the audience and afterwards reproduced in the machine. The description of this ingenious invention was listened to with close astention, and the reproductions elicited hearty applause. At the close the apparatus was thrown open to inspection, and several of the etched plates were carried away as souvenirs. One of the most interesting numbers of the programme was the rendering of Oxenford's baritone "Man-O'-War Song," on the gramophone, with direct piano accompaniment by Mr. George H. Guy. The experiment was very successful and pleasing, the two instruments being played, so to speak, in admirable accord.

At the meeting of the council on Dec. 16, the following gentlemen were elected to associate membership, bringing the total of members in good standing to over 500. There were also seven transfers to full membership.

P. H. Alexander, president Alexander, Barney & Chapin, 20 Cortlandt street, New York City.

Charles E. Dressler, maker of scientific and electrical apparatus, College of the City of New York, 17 Lexington avenue, New York City.

E. L. French, draughtsman, Mather Electric Co., Manchester, Conn.

Arthur Handley, electrical engineer, Electrical Engineering Co. of Ireland, L't'd. 61 Dawson street, Dublin, Ireland.

George Mayer, mechanical draughtsman, Edison General Electric Co., 68 Broad street, New York city.

Wm. F. Murphy, electrician, Spartanburg Electric Light and Power Co., Spartanburg, S. C.

F. B. H. Pain, consulting electrical engineer, Chas. Pain & Sons, 71 Broadway, New York city.

Chas. Lane Poor, tutor, College of the City of New York, 17 Lexington avenue, New York city.

Samuel Sheldon, A. M. Ph. D., professor of physics and electrical engineering, Polytechnic Institute, Brooklyn, N. Y., residence, 20 Sidney place.

Wilfred J. Spruson, member of the firm of Hepburn & Spruson, consulting engineers and electricians, 169 King street, Sydney, Australia.

M. C. Sullivan, with THE ELECTRICAL ENGINEER, 150 Broadway, New York city.

John Waring, consulting electrician, The Perkins Electric Lamp Co., Manchester, Conn.

"ELECTRICAL UNITS" AT THE ELECTRIC CLUB.

"Electrical Units of the Present and Future," was the subject of a lecture delivered on December 18, before the Electric Club, by Prof. Francis B. Crocker, of Columbia College, who showed the real meaning and the way of determining the numerous electrical units, such as the volt, ampere, ohm, etc., which, though in common use, are not understood even by many electrical men. The subject of a name for the new unit of self-induction was also discussed. Prof. Crocker has proposed that the new unit should be called a "Henry," after Prof. Joseph Henry, and it is thought that this name will be generally adopted. If it is adopted it will be the first American name for an electrical unit. Prof. Crocker made his lecture extremely interesting, accompanying it with a large chart and with examples of the standard units, such as the B. A. ohm, Clark cell, etc.

The club, before listening to Prof. Crocker's lecture, amended its by-laws, increasing the limit of membership to 1,000. A change in the dues was also made, so that hereafter active or voting members will pay $40 and associate members $20 a year. Life memberships in the club cost $500, and about twenty have already been taken.

REPORTS OF COMPANIES.

EDISON GENERAL ELECTRIC CO.

The stockholders of the Edison General Electric Light Company have been notified that the fifth quarterly dividend of 2 per cent. on all the stock of the company, including such stock as is held in trust by the Farmers' Loan & Trust Co., has been declared payable February 2, to holders of record December 29. The payment of the dividend on stock held in trust, is, however, subject to the ratification of the action of the trustees in dissolving the trust, by the stockholders at their regular meeting on January 19, next. A special meeting of stockholders will be held on the same day for the purpose of voting upon a proposition to increase the capital stock from $12,000,000 to $15,000,000.

STATUS OF THOMSON-HOUSTON STOCK.

The Thomson-Houston Electric Co. make the following announcement: "The sale of the 60,000 shares at $50 per share was absolute and complete. The subscriptions received at the time, as was then well understood, were largely in excess of the amount allotted; 10,000 shares were sold and paid for in cash; 50,000 shares were sold at $50 per share, payable one-third in October, one-third in January and one-third in April, with interest at 6 per cent. from October 1. Somewhat more than one third of the 50,000 shares were paid for in October. The total amount received by the company on account of this sale is at the present time a little in excess of $1,600,000. There has been no delivery of any stock for which payment has not been received in full in cash. The Thomson-Houston Co. realizes net $49 per share after paying all commissions, discounts and expenses in connection with the transaction. In addition to the amount to be received by the company from the sale of stock in January and April, aggregating about $1,400,000 within that time, the company will also receive in cash from the sale of securities to the United Electric Securities Co. $450,000. The company has $6,000,000 more assets than at the end of its last fiscal year. It has $1,250,000 less liabilities. With unsecured debts of less than $50,000, its entire indebtedness, less cash on hand, is scarcely more than the amount of cash to be received by it as above indicated between now and May 1. There is no reason why any creditor or any stockholder should remain in ignorance of any essential facts concerning the condition of the Thomson-Houston Co. Its affairs are always open to the inspection of anyone who has a right to make any inquiries concerning them."

AFFAIRS OF THE WESTINGHOUSE CO.

Westinghouse stock was quoted in Pittsburgh on Wednesday last at 13¾ bid and 14¼ asked. The Pittsburg *Telegraph* of December 17, reports that at that time, the committee having in hand the raising of money to assist the Westinghouse interests had raised all but $30,000 of the $500,000, and that the committee had no doubt that the whole amount would be secured the next day. It is understood that the whole sum has since been subscribed.

DIVIDENDS.

BOSTON MASS,—The Edison Electric Illuminating Co., of Boston, has declared a quarterly dividend of 1 per cent. payable January 15.

THE AMERICAN BELL TELEPHONE directors at their meeting declared the regular quarterly dividend of $3 a share, but took no action whatever in regard to any further issue of stock.

STOCKS AND BONDS.

HOLYOKE, MASS.—The Holyoke Street Railway Co. will increase its capital stock from $50,000 to $150,000 and adopt electricity as motive power.

EASTON, PA.—The Edison Illuminating Co., of Easton, is about to double the capacity of its plant, and has voted to increase its capital stock from $100,000 to $200,000.

MINNEAPOLIS, MINN.—There is a split in the Electro-Matrix Co., and two sets of directors have been elected.

ATTLEBORO, MASS.—One of the most successful electric roads in this country is the new Attleboro & North Attleboro railway, which carries 1,200 passengers a day in territory in which there are not over 15,000 people. The line competes with a steam dummy line, and the stock sells at $165 a share.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED DEC. 16, 1890.

Alarms and Signals ;—

Means for the Transmission of Meteorological Indications, H. J. Haight, 442,881. Filed Nov. 29, 1889.

Improvements upon devices previously patented by the same inventor for the transmission of meteorological indications from a main or central observatory to distant receiving stations. The object of the present invention is to reduce the number of indicating instruments at the several stations, and the invention consists chiefly in means employed for enabling a plurality of indications to be exhibited successively upon indicating instruments less in number than the number of the indications.

Multiple-Circuit Closer, H. J. Haight, 442,882. Filed March 14, 1890.

The invention relates to devices which enable a plurality of indicating instruments to be brought one by one into electric communication with a single source of electricity, by which all the indicating instruments may be controlled by a single switch or key.

Conductors, Conduits and Insulators :—

Underground Conduit for Electric Conductors, J. S. DuBois, 442,868. Filed Mar. 15, 1886.

The conduit consists of an enclosure of asphalt or brick surrounding a frame secured therein and provided with supporting brackets, and anchor pieces, for the support of tubes or troughs upon the brackets ; the tubes or troughs are provided with longitudinal slots and flanges on their upper sides, the flanges serving to secure the tubes in position.

Dynamos and Motors :—

Portable Electric Motor and Cloth-Cutting Machine, E. D. Weyburn, 442,654. Filed Apr. 5, 1890.

Adaptation of electric motors to operate cloth-cutters in large clothing factories and similar establishments. The motor is suspended from a track passing above the cutting tables and the cutter is actuated through a flexible shaft.

Regulation of Electric Motors. E. W. Rice, Jr., 442,668. Filed Oct. 20, 1890.

Replaces the resistance coils usually employed for insertion in the armature circuit of an electric motor, upon starting, by coupling in series circuit with the armature, when starting from a state of rest, a counter potential generator. The counter-potential generator is maintained in circuit until the speed of the armature becomes such as to generate of itself sufficient counter-electromotive-force to render injury from the passage of an excessive current no longer liable to occur.

Dynamo-Electric Machine or Motor, N. H. Edgerton, 442,870. Filed Oct. 22, 1890.

Design and construction for cheapness, simplicity and compactness. The frame forms a double yoke for the field-magnets and consists of two sections, one forming three sides and the other forming the fourth. The frame is formed with oppositely-located bearings for the amature shaft.

Electrolysis :—

Process of Desilverizing Lead by Electrolysis, T. D. Bottome, 442,661. Filed Jan. 2, 1890.

Claim 2 follows :

The process of refining lead containing silver, consisting in electrolytically dissolving the said lead in an electrolytic solution composed of ammonium or synergistic compounds dissolved in water and kept saturated with carbon dioxide, whereby lead carbonate precipitates and silver deposits upon cathodes, substantially as described.

Heating : —

Electric Heater, C. H. Talmage, 442,649. Filed Apr. 11, 1890.

Claim 2 follows :

In an electric heater or converter, the combination of the primary coil surrounding a core of metal strips or wire and a secondary coil of thin sheet metal surrounding the primary coil, whereby the heat produced by the induced current is radiated for heating purposes, substantially as described, and for the purposes set forth.

Electric Cooking Apparatus, E. Abshagen, 442,932. Filed Aug. 4, 1890.

Consists of a closed vessel filled with an oily fluid and provided with suitable cooking compartments heated by the fluid ; the oily fluid is heated through the instrumentality of an electric conductor of considerable resistance immersed in the fluid and in circuit with a generator of electricity.

Electric Steam and Hot-Water Generator, E. Abshagen, 442,933. Filed Aug. 4, 1890.

A closed compartment is located in the boiler or vessel containing the water to be heated ; the closed compartment is filled with an oily fluid in which is immersed an electric conductor, as in No. 442,932, above.

Lamps and Appurtenances :—

Electric Arc Lamp, J. E. Giles, 442,617. Filed Aug. 21, 1889.

Relates to arc lamps for use in series in a circuit of constant potential.

Claim 6 follows :

In an arc lamp, the combination of a gravitative carbon-holder, a rack on the carbon-holder, a fixed train of wheel-work for regulating the feed of the same, the axis of the wheel engaging the rack being movable, a scape-pallet controlled by a regulating-coil for permitting the movement of the train, and a coil in the main circuit for lifting the engaging wheel.

Bracket for Combined Electric and Gas Lighting, J. Gunn, 442,666. Filed March 12, 1890.

The invention consists chiefly in the construction of the joint which enables the bracket to be turned in any desired direction so as to bring the light where it is most needed.

Electric-Light Holder, J. B. Moore, 442,665. Filed June 20, 1890.

A device for attachment to an incandescent electric lamp, by which it may be readily attached to a desk, table, or other support, or placed upon a desk or table in the manner of an ordinary lamp stand.

Pendant Cleat, A. R. Bush, 442,746. Filed June 4, 1890.

Designed especially to be used as a substitute for blocks of the usual rosette form, and particularly intended for use in mills, factories and the like, and especially for high-tension systems.

Portable Electric Lamp, D. G. Fitzgerald and A. H. Hough, 442,969. Filed Sept. 9, 1890.

Especially intended for the use of miners. Includes a case for a battery, and special protection for the lamp bulb.

Claim 1 follows :—

In portable electric lamps, a vessel containing or constituting the cell or cells inclosed in an outer casing, between which casing and the said vessel is interposed elastic material, substantially as herein before explained.

Electric Cut-Out, D. J. Cartwright and J. S. Potter, 443,068. Filed July 14, 1890.

For use with incandescent electric lamps. Design and construction to secure ease and convenience in attaching and detaching lamps from their circuits ; and also with a view of preventing water from getting at the internal parts of the cut-out.

Measurement :—

Electric Meter, A. W. Meston, 442,705. Filed July 22, 1890.

The invention consists of three general features, as follows : A device for measuring the quantity or strength of the current, a device for producing a motion of uniform speed, and a device for registering, by means of the two devices first named, the product of the current strength and time.

Claim 1 follows :—

In an electric meter, the combination, with a solenoid and its core and a lever actuated thereby, of a revolving surface having teeth increasing in number along the generating-line of said surface, and gear carried by the lever, said gear arranged to engage with the teeth on said revolving surface, substantially as and for the purposes specified.

Electrical Measuring-Instrument, E. Weston, 442,843. Filed July 1, 1890.

Apparatus for measuring difference of potential in an electrc current established between terminals. The invention embodies a fixed coil, and a movable coil suspended in the field of force of the fixed coil by a filament, the two coils being electrically connected. On establishing a current through the coils the movable coil is deflected to an extent depending upon the difference of potential existing between the terminals of the device, and the amount of deflection is indicated by a needle moving over a suitable scale.

Reversing Key, E. A. Colby, 442,800. Filed Feb. 28, 1890.

A reversing key adapted for use in a measuring instrument such as that patented to Edward Weston, Nov. 6, 1888. (Letters patent No. 392,387.) Through the combination of the key with the above mentioned instrument the current can be reversed through the rotating coil of the voltmeter without affecting a corresponding reversal of the current through a fixed resistance coil also contained in the Weston voltmeter.

Metallurgical :—

Magnetic Ore-Separator, G. S. Finney, 443,042. Filed March 25, 1890.

The magnetic wheel of the separator comprises a series of electro-magnets having a common core and having the poles extended from opposite ends of the series cross-wise of the plane of the wheel's circumference and forming elements of the wheel's circumference.

Magnetic Separator, G. S. Finney, 443,043. Filed March 25, 1890.

The magnetic wheel of the separator comprises a series of magnets on a common rotary core and alternating as to their polarity ; each magnet has its poles extended continuously around the plane of the wheel's circumference and forms an element of its cylindrical surface. A non-magnetic endless belt surrounds the wheel and affords a support and conveyor for the material to be treated.

Magnetic Ore-Separator, G. S. Finney, 443,044. Filed March 25, 1890.

The magnetic wheel of the separator comprises a rotary shaft provided with heads, and permanently magnetic bars extending lengthwise between the heads, alternating in polarity around the wheel, and forming elements of its cylindrical surface.

Metal Working :—

Method of Welding Metals Electrically, C. L. Coffin, 442,954. Filed June 9, 1890.

The bars, rods, or other articles to be welded together are not placed directly in contact with each other while the heating current is passed through them, but the ends to be welded are in contact with a conductor of similar or less resistance. The first claim describes the method as consisting in connecting each article with one pole of a generator of electricity, making contact between the ends to be welded and an electric conductor of equal or less resistance, passing a heating current through the articles and said conductor, and completing the weld by pressure.

Miscellaneous :—

Automatic Recording Apparatus for Vehicles, J. Bellussich, 442,849. Filed July 11, 1889.

Apparatus for recording the running time of a vehicle and also for recording the time of occupancy by a passenger. The circuit-closer for the electro-magnetic apparatus operating the running-time record is controlled by the motion of the vehicle, while the circuit-closer for the device operating the record of the time of occupancy is controlled by the passenger on taking his seat.

System for Indicating Thermometric Records, H. J. Haight, 442,880. Filed May 3, 1888.

Apparatus to enable a single operator at a main station or observatory to transmit simultaneously by electric means to a series of sub-stations indications which are received or known at the main station and automatically to indicate such indications at the several sub-stations without the necessity of the presence of attendants at the sub-stations when the indications arrive.

Electric Switch, J. O'Brien, 442,996. Filed Aug. 28, 1890.

The object of the invention is to provide a switch by means of which a break or disturbance occurring on a telephone circuit, or other similar circuit, can be corrected as soon as the cause is detected. The invention consists in a novel arrangement of circuit-connections and switch-levers.

Method of Protecting Buildings from Lightning, N. D. C. Hodges, 443,048. Filed Sept. 28, 1889.

Consists, first, in receiving atmospheric electricity as it collects in the vicinity of a building upon a conducting surface ; second, in diffusing the collected electricity upon a large surface of finely divided badly-conducting substance; third, scattering the badly-conducting substance, and so reducing the charge, and, lastly, in conducting the residue of the charge to the ground.

Railways and Appliances :—

Station Indicator, Louis Casper, 442,610. Filed Sept. 12, 1888.

Apparatus, including electro-magnetic devices, for indicating streets or stations upon a railway as they are reached by a car.

Claim 2 follows :

In a station-indicator, the combination, with two electro-magnets and an armature pivoted to swing between them, angular pawls pivoted to the upper end of the armature, a shaft, two ratchet-wheels on said shaft, a roller on said shaft, and a band secured to said shaft and bearing the station names, substantially as herein shown and described,

Electric Trolley Switch and Trip, R. C. Hopson, 442,623. Filed May 5, 1890.

A line switch and junction-trip for overhead railway conductors.

When it is not desired to switch a passing car from the main line, a "trip" that may be provided upon the trolley engages a hanger extending below the switch-plate and jumps the trolley over the switch and back upon the main trolley wire.

Storage-Battery Electric Car, J. Stephenson, 442,744. Filed Aug. 2, 1890.

Design and construction of car, adapted to facilitate the renewal or removal and replacement of storage battery cells.

Claims 1 and 2 follow :

1. A car with foot-panel hinged at its lower verge and with a guard-rail

arranged to support the panel in a horizontal position with supports from the car-body sill, substantially as and for the purpose described.

2. A car with its foot-panel hinged at its lower verge, and a series of locks at the opposite verge of the panel, the bolts of each lock connected with a lock-opening sliding bar, substantially as described.

Train-Telephone, R. S. Carr, 442,799. Filed Feb. 17, 1890.

An intercommunicating telephone service for railway trains. The telephones are pneumatic and are connected together through the medium of tubes containing air under pressure.

Safety Device for Overhead Conductors, R. A. Morgan, Jr. 442,816. Filed March 14, 1890.

The safety-device or switch is made of two or more parts or members, so constructed and adapted as to secure, by means of a spring or a spring-actuated member, a separation of parts adequate to preclude the formation of an arc when contact is broken.

Trolley Line Switch, W. M. Rumsey, 443,004. Filed Aug. 7, 1890.

An adjustable switch for overhead railway conductors.

Consists of an annular base plate provided with a series of slots and a clamping disc; the switch bars, attached between a base plate and clamping plate are adapted to be adjusted toward or away from each other, so that a cross over of any desired angle may be formed.

Trolley-Line Insulator, W. M. Ramsey, 443,005. Filed Aug. 7, 1890.

Consists of a bracket having a tapering circular opening formed therein and upwardly extending hooks, a cylindrical block confined in the circular opening, a bolt secured in the block, and a shoe or clamp attached to the bolt.

Magnetic Shield for Electric Motors, C. J. Van Depoele, 443,019. Filed Aug. 4, 1887.

Designed for the protection of the contents, including the passengers and their watches, of an electric railway car from the magnetizing effects of the lines of force from the field magnet of the motor. Consists of a sheet-casing constituting a magnetic shield permanently interposed between the motor and the interior of the vehicle.

Electric Signaling Device for Moving Vehicles, O. J. Depp and S. J. Munn, 443,074. Filed Aug. 4, 1890.

Claim 1 follows:

An electric signaling device for moving vehicles, consisting of a circuit controlling device located within the brake or switch handle of a car, an electric bell located on the said vehicle, a three line-circuit connecting the said bell with the said circuit-controlling device, and means whereby electricity is supplied to the said wires from the trolley or main line, substantially as described.

Trolley-Switch for Electric Railways, J. Jones, 443,081. Filed Sept. 25, 1890.

Especially adapted to single-track roads where the cars are side-tracked at certain points. The device embodies two movable sections of the conductor, one in the main line and the other in the branch, the sections being held in their normal position by gravity.

Telegraphs:—

System of Telegraphic and Telephonic Exchange, J. R. Smith and W. Childs, 442,784. Filed Sept. 27, 1889.

The object is to provide an exchange system whereby connections and disconnections may be effected at the central office by the operator at a local station promptly, secretly, and automatically.

Claim 4 follows:

A system of telegraph or telephone exchange having a switch-board in which circuit-wires terminate, an electrode-coupler attached to a movable belt supported and operated by one or more wheels, said belt and one of said wheels being in electrical connection in the circuit, and an electro-magnetic propelling device in a line from one of the stations in connection with said wheels to move said electrode-coupler into electrical connection with any and all of the circuits so terminating.

Telegraphy, A. G. Hummel and F. A. Graham, 442,808. Filed July 10, 1890.

Intended to provide a system especially adapted for rapid sending in the police or the railway service. For security and the detection of error provision is made for the printing of all messages, whether general orders or of whatever character, at both the transmitting and the receiving station.

Telephones and Apparatus:—

Means for Reducing Inductive Disturbances in Telephone-Circuits, J. J. Carty, 442,856. Filed Sept. 18, 1890.

An electrically symmetrical arrangement and interconnection of circuits adapted to distribute inductive disturbance in such wise as to neutralize its effect upon the telephone circuit, so arranged and interconnected.

Claim 1 follows:

Three or more metallic electric circuits extending parallel to each other, as described, combined with means such as the lateral branches or condensers, connected with the central circuit and extended along the more distant conductor of the side circuits, as specified herein, whereby each conductor of the said central circuit is enabled to exercise equal and like electrostatic inductive effects upon both near and distant conductors of its adjacent side circuits, for the purposes set forth.

Combined Electric Indicating and Telephone System, H. J. Haight, 442,883. Filed May 9, 1890.

The invention combines with an indicating system—such as a stock-quoting system, or the distribution of meteorological indications and the like—means for signaling or communicating between the various stations for other purposes than the transmission of the usual indications for which the system is established, and provides also a telephone system as part of the combination.

THE ELECTRIC RAILWAY FIGHT IN ORANGE, N. J.

At the meeting of the Orange Common Council on December 15, the statement was made by F. W. Kelsey, one of the opponents of the proposed electric railroad on Central avenue, that by January 1 he and some of his friends would be prepared to pay for a franchise provided the road was located south of Central avenue or parallel with that thoroughfare. Such a road would open up new territory and give the rapid transit needed without spoiling Central avenue, which is now devoted to dwellings, and is practically the only road on which it is possible to drive safely between Newark and the Orange mountains. In view of that statement the consideration of the ordinance by which the Aldermen proposed to grant the application of the Suburban Rapid Transit Company for a franchise for a railroad on Central avenue for a small consideration was laid over until the regular meeting in January.

LEGAL NOTES.

THE GOVERNMENT vs. WESTERN UNION—TO RECOVER $12,495 PAID FOR MESSAGES.

Before Judge Lacombe and a struck jury, in the United States Circuit Court, this city, trial was begun last week in a case in which the Government sues the Western Union Company and the Union Pacific Railroad Company, to recover $12,495.62. This is the amount paid to the Western Union for telegraphic messages sent by various departments of the Federal Government, over lines of wires extending from the Missouri River to San Francisco since 1881. The United States District Attorney, J. W. Mitchell, in presenting the case, stated that the acts of Congress under which the Central Pacific Road was organized, and the amendatory acts thereto, provided that the Government should be entitled to retain all fixed charges for Government telegraphic despatches, and apply the same to the payment of the bonded indebtedness of the road; and that all the earnings of the road, both for the transmission of freight and passengers and of telegraphic messages, 5 per cent. should be paid into the United States Treasury. The telegraph lines formerly operated by the Union Pacific Roads were surrendered to the Western Union by an agreement entered into in 1881, since which time the Government has had to pay for all its telegraphic messages. The further claim is made that by this surrender of the telegraph system of the road the 5 per cent. of the earnings of the Union Pacific to which the Government is entitled is diminished.

G. A. HALSEY vs. NEWARK RAPID TRANSIT RAILWAY CO.—POLES MAY BE PLACED ON A STREET.

Mr. Halsey's application was to have the Chancery Court enjoin the company and thus require it to remove the poles used by its electric road in front of Mr. Halsey's property. The poles are in the middle of the streets. Mr. Halsey's title runs, like most others, to the middle of the street, and he claimed that the poles infringed upon his property, and that such use of the street was not authorized by the laws regulating highways.

The Vice Chancellor, Van Fleet, denies the injunction, and the following points cover the main features of his interesting and forcible opinion. He declares:

That the complainant (Mr. Halsey) has a fee in the land occupied by the street, but this is subject to the public easement, or right of way.

That the fee when subject to such easement is of no beneficial interest to the holder.

That the public right to free passage over the land which is now used as a highway, not only means such methods of conveyance as were in use when the highway was laid out, but all improved means.

That since horse railroads have been decided to be a legitimate use of the highway, an improved plan of transportation must certainly be considered a legitimate use.

That the poles and wires have been placed in the street to aid the public in exercising their right of easy and rapid passage over the street.

That the company is legally organized under the street railroad law of 1886; that the law permitting the use of electricity as a motive power is in strict accordance with the first act, and that the State laws and municipal authority cover together the case completely and legalize the erection of the poles.

That the poles and overhead wires are a portion of the best, if not the only means, by which electricity can be successfully used for street car propulsion.

That the city's consent by resolution instead of ordinance was legal and sufficient.

That it is consistent with street uses that the authorities should adopt "the improvements and conveniencies of the age."

That the pole in front of Mr. Halsey's japannery forms no real obstacle to entrance to the yard.

That the electric current used by the company may be used with entire safety to everybody.

THE DENVER, COL., ELECTRIC LIGHTING CONTRACT VOID.

An important decision has been rendered by Judge Allen, in the case of Tabor et al. vs. The City of Denver and the Western Electrical Construction Company. A short time ago the city entered into a contract with the above company to furnish lights to the city for a specified time. Later suit was brought in the name of a number of prominent citizens and taxpayers to set aside the contract. The decision is in favor of the plaintiffs. Judge Allen holds that neither the city council nor any officials of the city had the power to make such contract, and that the ordinance making the contract, as well as the contract itself shall be void.

FINANCIAL MARKET.

QUOTATIONS ON ELECTRICAL STOCKS.

F. Z. Maguire & Co., Electrical Securities, of 18 Wall street, this city, report the following quotations of December 20, from New York, Boston and Washington; Pittsburgh, December 19.

NEW YORK.

	BID.		BID.
W. U. Tel. Co.	75	Edison Gen. Elec. Co.	84
American Tele. & Cable	83	Edison Gen. Co. Def'd	....
Centl. & So. Amer.	....	Consol'd Elec. Lt. Co.	...
Mexican	...	Edison Illu'g Co. N. Y.	70
Com. Cable Co.	....	U. S. Elec. Lt. Co.	80
Postal Tel. Cable	39	North Am. Phonograph	....

BOSTON.

	BID.		BID.
Thomson-Houston	42	Ft. Wayne Co.	11
" Pref'd.	26	Am. Bell	211
" Series C.	....	Erie	46
" " D.	5¼	New England	48¼
" Int. Co.	....	Mexican	.70 cts
Thomson Welding Co.	....	Trop. American	..
Thomson Eu. Welding	....	Edison Phon'gph Doll	....

WASHINGTON.

	BID.		BID.
Penna. Telephone	25	U. S. Elec. Lt (Wash)	135
Ches. & Pot. Telephone	....	Eck.&Sold. Home Elec.Ry.	52
Amer Graphophone	11	Georgetown & Tenallytown	45

PITTSBURGH.

	BID.
Westinghouse Electric and Manufacturing Co.	12¼

"TWO-AND-A-HALF-MILES-A-MINUTE."

Under the above title a lecture was delivered at the Franklin Institute on Dec. 16, by Prof. W. D. Marks. In the course of his lecture, which was extemporaneous, he described the overhead system, which "is now in possession of Boston," as an intolerable nuisance. Wires are being stretched everywhere over the city at a height of only 18 feet above the streets, and, aside from this practical inconvenience, there is the constant danger to pedestrians from breaking or falling wires. The company claims to carry a current of but 500 volts, but Prof. Marks said that, from his observation, it was often very much above 500. As to the storage battery car, he said there could be little doubt a battery would ultimately be perfected which would serve the purpose, but that it is not likely that it will prove as cheap as the use of the direct current. The storage plan, he thought, was cheaper than horses, but the dynamo will beat the storage battery. As to the underground conduit plan, he thought one could be devised which would be easily accessible for repairs and would not cost over $30,000 a mile, while the power ought to be produced at a cost of not over five cents per horse-power per hour, including all clerical and administrative expenses.

The lecturer touched briefly also, upon the elevated and underground systems of rapid transit, holding, with reference to the former, that there was no reason why the elevated railway should be made such a horror as it is in New York. Different methods of construction and the use of electric motors would obviate much of the present annoyance. With reference to the high speeds of which he had spoken Prof. Marks said that they could only be attained by electricity, and that it would involve essential changes in road bed, rolling stock, etc. After pointing out the advantages of a system of electric motors, Prof. Marks said he would not hesitate personally to drive a motor from Philadelphia to New York at the high speed he had named—2½ miles a minute.

FRANK KITTON ON ELECTRIC TRACTION IN BUFFALO.

"The Advance of Electric Traction," was the title of an interesting paper read before the Buffalo Electrical Society last week by Mr. Frank Kitton of the Western Union. He said that less than two years ago he had addressed the Society on the same subject, and at that time had predicted that public prejudice against the use of the trolley system in Buffalo would give way before the necessity for a better street-car service, and that electric motors would eventually displace horse power as an agent in operating street-cars. After speaking of the opposition encountered by the Street Railway company in obtaining the necessary permission to make the change, Mr. Kitton said that the danger which at that time was so much apprehended from the introduction of electricity did not appear to agitate the public mind so much as the question so often asked, and so seldom satisfactorily answered, When will the electric cars commence running? From the statistics gathered up to date there were, it appeared, no fewer than 246 electric roads in this country, operating 2,024 miles of track and employing 3,830 motor cars, the single trolley system, with only a few exceptions, being that in general use. Mr. Kitton then described the various systems.

TRADE NOTES AND NOVELTIES
AND MECHANICAL DEPARTMENT.

NEW CATALOGUE OF ELECTRIC STREET RAILWAY SUPPLIES.

The Electric Merchandise Co., 11 Adams street, Chicago, Ill., now so widely known as dealers in electric street railway supplies of all kinds for all systems, are busily engaged in preparing a "mammoth new catalogue" of everything in this line heretofore on the market and also of many new and highly valuable devices and specialties. It will be profusely illustrated with handsome cuts and each article described clearly and will be ready very shortly. This valuable book should be in the hands of every electric street railway man in the country, and all should write for a copy without delay, as it will form a perfect "encyclopedia" of electric railway work, and everything pertaining to this branch of electrical work will be contained therein. Mr. Mason, the manager of the company, is having an extra large edition prepared to meet the large demand, as he intends sending it broadcast everywhere and expects to receive applications for a copy from everyone interested, as it will be something entirely novel in its completeness and scope.

ELECTRICAL PRODUCTS OF THE REVERE RUBBER CO.

The production of numerous substitutes for hard and soft rubber, as used in electrical apparatus, has only tended to increase the variety of forms in which this may become a part of various appliances. The strength and firmness of the hard rubber, the elasticity of the soft, together with the durability and high insulating qualities of both have given them a well-earned foothold. Moreover the process of manufacture has been perfected, so that with the aid of specially designed moulds and tools, rubber pieces of high quality can be made at a comparatively low price. The variety of sizes and shapes in which the rubber parts can be made is almost endless and serves to adopt this material for use in a large range of electric appliances. The design of pieces for such uses properly comes within the sphere of the consulting electrician, and yet the rubber manufacturers have generally undertaken this work. Accordingly, the Revere Rubber Co. has established an electrical department, which will not only furnish rubber pieces as now in common use, but will also be prepared to design special fittings to meet any special conditions.

The Western agency of this department is in the hands of Mr. George Cutter, whose long and varied experience in electrical work would seem to fit him specially for this position. The Revere Rubber Co. has a well-established reputation as a maker of a high grade of rubber goods, and its placing this department in the hands of so practical an electrician as Mr. Cutter will be welcomed as a decided step forward.

A NEW ELECTRIC RAILWAY SWITCH.

Messrs. Charles W. Smith and Cornelius J. Lyons, of Boston, are the inventors of an electric switch to be used where the electric system is in operation on street railways. The West End Street Railway Company has a model of the invention, and may give it a trial before long. The switch appears to be a practical one and very easy in its action.

THE SHAVER MOLECULAR TELEPHONE.

The Shaver telephone has just been successfully introduced in Skowhegan, Me., and it is said that a number of business men will introduce it and push its interests.

HUNT ENGINEERING CO.

A fine installation has just been completed by the Hunt Engineering Co., in the electrical plant for the new theatre at Norwich, Conn. A very fine switchboard of slate, cased in a frame of solid carved English black oak has been put in, on the stage, with subsidiary switching arrangements in other parts of the house. There are also special devices for turning the lights down when soft effects are required, and moonlight or sunset effects are obtained very successfully. Okonite wire is used for the circuits. The plant started off at once smoothly and easily, and the local press speaks most highly of the Hunt Company's work.

ACTIVITY OF THE ELEKTRON CO.

The Elektron Mfg. Co. have recently sold to Messrs Warfel & Geist, of Lancaster, Pa., 30 h. p, in Perret electric motors. These machines will be supplied with current by the Edison Electric Illuminating Co., of Lancaster, and will furnish power for all the machinery in the large brick building recently completed by Messrs. Warfel & Geist, including large Hoe presses for printing the daily and weekly *New Era*, as well as all the job presses, which go to make up one of the best and largest printing establishments in the State. Messrs. W. & G. have had experience with several other motors, but after a thorough investigation and a visit to Brooklyn and New York, where they witnessed the motors in operation, placed their contract for Perret machines.

The following is a sample of the testimonials now being received by The Elektron Mfg. Co.

MINNEAPOLIS, MINN., Dec. 3rd, 1890.

MR. F. J. RENZ, Agent.

Dear Sir :—In reply to yours of the 3rd in regard to testimonials will say that I am so well pleased with the Perret Motor in *all respects* that I will permit your people to write anything they see fit over my name, providing it is *all in favor* of the PERRET, and will do all I can in any way to help you in Minneapolis. Yours respectfully,

F. G. WARD, Mgr.,
The Great Atlantic & Pacific Tea Co.

THE ANDERSON TROLLEY POLE.

ONE of the most important necessities of a good overhead trolley system for electric railroads is the trolley pole, and many forms of pole have been used with varying success. Wood, gas pipe, iron pipe, seamless steel tubing with three or more joints have all been tried. Probably the most successful and durable has been the seamless steel tube but the necessity of making the pole in lengths, so as to gradually give it a taper appearance, has proved a drawback. To remedy this defect Messrs. A. M. and J. Anderson, of 21 Hamilton street, Boston, have just brought out a new pole which is made in one piece of soft steel and is gradually and evenly tapered down from the butt to the point. It is neat and light and is at the same time extremely strong and durable, being made of the very best material. The pole will stand a very heavy strain and is so tough that it can be doubled and then straightened out again without in any way destroying the material. A number of these poles are already in service on the West End Street Railway, of Boston, and electric street railways would do well to give them a trial.

THE ANDERSON TROLLEY POLE.

CHANGES IN WESTINGHOUSE MANAGEMENT.

A paragraph from Pittsburgh of Dec. 15, says: "The *Leader* is now in a position to state on authority entirely trustworthy that the changes in the Westinghouse Electric Company management outlined in the Saturday issue will be made. General Manager Byllesby will retire to make way for Mr. A. M. Byers. Assistant Treasurer McCullough will also retire, but as yet his successor has not been announced. The banks in interest here decided to advance the money asked for, and only minor details are to be looked after before the deal is closed. This will put the electric company—certainly a money-making concern when properly managed—on a sound footing and it would seem that the improvement noted in the stock to-day reflects these changes."

W. H. GORDON & CO.

W. H. Gordon & Co., 115 Broadway, report large sales of the Star Electrix specialties, for which they are general selling agents. The sockets especially have been in large demand and orders are booked way ahead for future delivery. They are now fully stocked with the switches and cut-outs and can fill orders promptly.

These goods are not only mechanically well made but are also artistic in appearance and electrically the best ever offered on the market.

THE C. & C. "BLOWER" ON THE "BALTIMORE."

The C. & C. Electric Motor Co. less than twelve months ago manufactured the first of its blower and motor combinations with which most people versed in electrical appliances are now familiar. This apparatus was primarily designed for use in dynamo and engine rooms of steamers and in other places where it is essential to produce a rapid and thorough ventilation and where the space is circumscribed. Owing to the extreme compactness of the machine it may be placed in the smallest room and proves a most powerful exhaust. The apparatus was first used on the U. S. S. "Baltimore" and Capt. Schley commanding that ship declared in a letter written to the "C. & C." Co. that it gave "perfect satisfaction." The installation on the "Baltimore" has been followed by others on the "Chicago," "Charleston" and "Petrel," and three more blower combinations are now under construction by the "C. & C." Company for others of our new cruisers. The Italian Navy not to be left behind ordered two of these blowers some few months ago and after giving the apparatus a thorough test have recently, through their agents in Milan, placed a further order with the "C. & C." Company, for nine, including six of the No. 7, or largest size machines.

GIBBON DUPLEX STREET RAILWAY TRACKS.

An interesting pamphlet has been issued from the Gibbon offices, No. 1 Broadway, New York, relative to the Gibbon duplex street railway tracks recently illustrated and described in our columns. The pamplet abounds in cuts showing the various features of this excellent and economical system, and there is some very pithy descriptive matter as well as pertinent argument on the subject. For their own sakes, electric railway men should look into this method of track construction.

ELECTRIC RAILWAY WORK AT JAMESTOWN, N. Y.

The Jamestown Street Railway Co. has contracted with the Short Electric Railway Co. for complete electrical equipment, including twenty 15 h. p. motors and ten car equipments, three 80,000 watt generators, and line construction for about 12 miles of track. The contract was awarded to Mr. T. C. Frenyear, who represented the Short Co. at Jamestown, after very sharp competition. The apparatus ordered is sufficient to provide for the new line to Lakewood on Chautauqua Lake. It is expected that the road will be in operation by May 15th. The installation will be a notable one, inasmuch as the grades are numerous and heavy, there being three of more than 9 per cent. The power station will be a model one in every respect, and large enough to accommodate eight 110 h. p. generators. It is situated on two railroads and the Chautauqua Lake outlet, so there will be no handling of coal, and water for condensing purposes will be abundant.

ELECTRICAL TRANSMISSION OF WATER-POWER.

The Gray Current Motor Co., of Elgin, Ills., has, through the efforts of Capt. C. F. Dunderdale, of the Rookery Building, Chicago, secured the large water power at Oregon, Ills., and will at an early date install a large power plant there, consisting of a large flume to be built to take the flow of the Rock River, and in this flume will be placed the Gray current motors, which will deliver their power to large electric generators, and which in turn will, through the medium of cables, distribute the power to manufacturing establishments in the town operating by electric motors.

It is the intention of the Gray Co. to install a plant of a capacity to deliver some three thousand horse power of electrical energy in the town and make available for manufacturing sites large parcels of land hitherto too distant from the waterfall to be of value. This will give a great boom to the town and made it sought after by manufacturing concerns looking after an elegible site for a permanent place of location.

Since natural gas has shown itself so unreliable, water-power sites are much desired, but unfortunately there are but few near Chicago, and those few are already overloaded.

The engineering work will be under the direction of Capt. Dunderdale, who is well versed in all the details appertaining thereto, and has had large experience in this kind of work. His enterprise will create a new era in the prosperity of the town, and the example set will doubtless be followed in other places, as many inquiries are already pouring in to him from various points where the people are desirous of having a similar establishment erected and increased power from their waterfalls obtained for local requirements.

MR. O. T. CROSBY, the manager of the Southern District of the Edison General Electric Co., has resigned, and has proceeded from New Orleans to Boston, where he assumes new duties in the Thomson-Houston Electric Co., associated with Capt. Eugene Griffin.

THE FORT WAYNE ELECTRIC COMPANY have just taken an order for a 1,200 light alternating equipment for the Morristown, N. J., Electric Light, Heat & Power Co.

McCREARY'S MOISTURE-PROOF SOCKET PROTECTORS.

INCANDESCENT lamps are frequently placed out doors and where this is the case means must be provided for preventing the entrance of moisture into the socket which would cause leakage or even a short circuit. Rubber envelopes have heretofore been

McCREARY'S MOISTURE PROOF SOCKET.

provided for the sockets in such cases, but experience has shown that they harden and crack and frequently require a new one every time the lamp is changed ; and in addition they require the removal of the socket to adjust them.

To obviate this difficulty the McCreary Electrical Specialty Co., of this city, has brought out the socket protector illustrated in the accompanying engraving. As will be seen, it consists of a metal cap A containing a rubber gasket. The socket is enclosed in a metal shell B, the opening where the lamp is inserted being covered by a rubber neck C. By this construction the renewal of a lamp requires only the removal of the rubber neck C, which is as easily adjusted as the lamp. The extremely low cost of the rubber neck makes the use of this device very economical.

The McCreary socket evidently obviates the necessity of glass globes for outdoor incandescent lamps, which not only obstruct considerable part of the light, but are expensive and liable to breakage.

THE F. & M. DEPT., HARRISBURG CAR MFG. CO.

While most people are aware that this company is still turning out Ide and Ideal engines to the utmost capacity of its shops, still the impression seems to be current that the foundry and machine department is crippled badly by the recent failure of the Harrisburg Car Mfg. Co., whose affairs are now in the hands of a receiver.

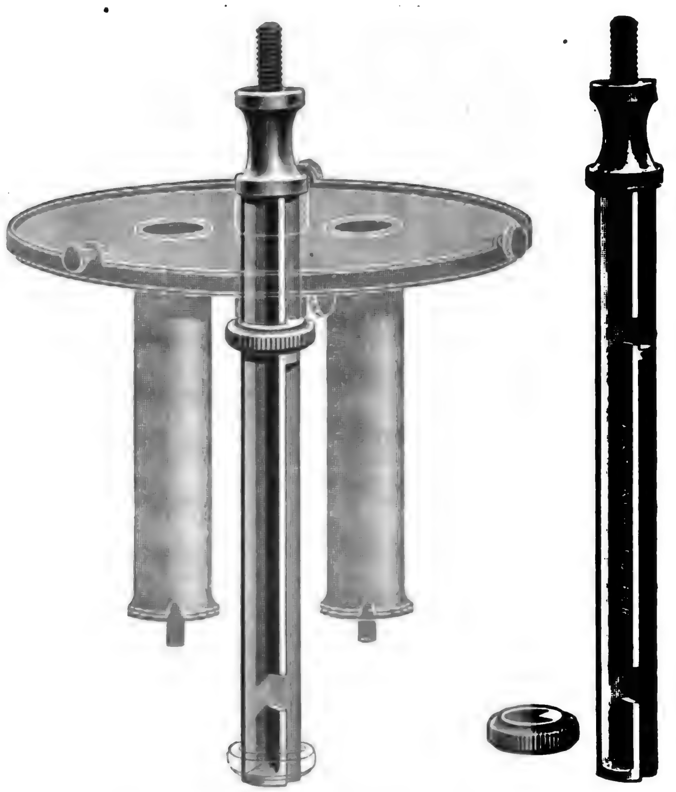
The business of the " F. & M." Department is, in fact, better than ever, and in order to give its functions more scope, it will soon be reorganized as a separate and distinct company with a large working capital. In the meantime John Post & Co., of Boston, and W. R. Fleming & Co., of New York, agents, keep the Harrisburg people busy filling orders.

The accounts of the F. & M. Department will, we are informed, positively be paid in full.

THOMSON-HOUSTON PLANTS.—The Western Isolated Department of the Thomson-Houston Electric Co. have received orders from the Bi-Metallic Mining Co., of St. Louis, for 200 incandescent lights ; the Albert Dickinson Seed Co., Chicago, for 100 incandescents, and G. B. Lewis & Co., Watertown, Wis., for 100 incandescents.

CUTTER'S GLOBE HOLDER FOR ARC LAMPS.

In trimming arc lamps, much time is often lost either because the globe is fixed and in the way, or because the arrangement for slipping it down while the carbons are being renewed is imperfect. Thus in the case of the Thomson-Houston double carbon lamps, the globe-holder slides on a brass tube and is held in place by a screw pressing against this tube. To insure the grip of the screw, the trimmers will often use their pliers on it, and in a short time the tube becomes indented or even split, the screw is bent and sticks, and the ring no longer slides freely. All this causes a loss of time in trimming the lamp and does not tend to improve the good humor of the trimmer. As a simple substitute for this bothersome arrangement, George Cutter, of Chicago, has brought out the device illustrated above. As the cuts show, a rod with a star-shaped cross-section is used instead of the tube, while the screw is replaced by a ring which is adapted to engage the rod at two points. When in use the globe-holder proper rests on this ring, which is knurled so as to be readily turned with the fingers. A slight raising and turning of the ring allows it to drop to the end of the rod, thus lowering the globe out of the way. After the lamp is trimmed, the ring is raised again and a quarter turn brings it back to its original position, where it supports the globe-holder securely. To remove this entirely, the ring is slipped down until opposite the lower notch in the rod, where both the ring and the globe holder can be taken off together. The globe can then be replaced and the holder slipped back and clamped in place in an instant. Thus, it takes but a moment to lower the globe where it will be out of the way, to raise it again into position, or to remove



CUTTER'S GLOBE HOLDER FOR ARC LAMPS.

it altogether. Such a labor saving device ought to pay for itself in a short time, and as it is simple and well made it may even outlast the rest of the lamp. As it fits any Thomson-Houston double carbon lamp, it will find a ready market wherever these are used. George Cutter is pushing this device from his office at 833 "The Rookery," Chicago.

ELECTRICAL SUPPLY CO., CHICAGO.

Mr. M. M. Wood is now with the Electrical Supply Co., of Chicago, in their engineering department, having severed his connection with the General Edison Electric Co., Portland, Ore., as district electrical engineeer.

THE EUREKA TEMPERED COPPER CO., of North East, Pa., report shipments for October and November of their tempered copper goods in excess of any amount previously shipped in any other four months since they began business.

DALLAS, TEX.--The Dallas Electric Co. will issue $300,000 of bonds for the purpose of improving its electric light plant.

GREAT WESTERN ELECTRIC SUPPLY CO.

The above-named house are doing a phenomenally large business in general electrical supplies of classes and orders are pouring in from all over the country. The demand for Simplex wire, carbons, porcelain and glass specialties and fixture, are unprecedented in the history of the house.

"DAISY CHAIRS" ON THE NEWTON, MASS., ELECTRIC RAILWAY.

Mr. R. T. White is in receipt of the following from F. G. L. Henderson, superintendent of the Newton Street Railway Co., which is running heavy electric cars over its lines: "We have recently laid in Newton and Waltham, five and one-half miles of track, more than three of which are laid on your chairs, and since they have been in use, they have given perfect satisfaction.

"When laying track in Newton, we gave them a severe test, by running a seventeen ton steam roller over our road bed, first filling it in with ten inches of crushed rock. We found no evidence of any failure to hold this immense weight and consequently I have full confidence, that if the material of which it is made, is kept up to the proper standard, your chair will do all that you claim for it.

"I see no reason why it should not meet with the approval of street railway managers who will give it a trial, as its low price and durability are points which surely ought to commend it to them."

AN IMMENSE STOCK.

The Great Western Electric Supply Company, 190–192 Fifth avenue, have got their five-story and basement building filled from roof to cellar with all kinds of the choicest electrical supplies and are carrying, it is said, probably the largest stock of any supply company in the country, that at present on hand aggregating over $250,000 in value.

NEW ENGLAND TRADE NOTES.

The Standard Electric Co., of Vermont, have sold a 200 light plant to the East Shore Terminal Co., of Charleston, S. C., and a 50 light plant to the Beaver Mills Co., Keene, N. H.

H. N. Bates & Co., of Boston, have secured the order to furnish the shafting, pulleys and friction couplings for the Johnstown Electric Light & Power Co., of Johnstown, N. Y. The order calls for 12 pulleys, and Hunter friction couplings for about 600 h. p. and about 200 fe t of shafting. This plant will be made a model plant as regards the shafting arrangements, no expense being spared to make it complete. The bearings will be on special frames, and the shafting of special forged steel.

Pettingell-Andrews Co.—The Boston stock exchange has admitted for dealings in the unlisted department the Pettingell-Andrews Company, which is engaged in the electric light and railway supply business; capital, $200,000, in 8,000 shares of $25 par value. The officers are: F. E. Pettingell, president; D. A. Andrews, Jr., vice-president; D. A. Andrews, treasurer; C. B. Price, secretary; and they, with Ambrose Eastman, are its directors. The business of the Pettingell-Andrews Company has been steadily increasing throughout the past year, and they have just declared a semi-annual dividend of 5 per cent. payable on December 1st. They have just been appointed exclusive New England agents for the well known Paiste switches. Mr. F. E. Pettingell has just returned from Chicago and the West, where he reports business as extremely brisk in their specialties. Mr. D. A. Andrews, Jr., has just made a complete tour of the South, going as far as New Orleans, and secured good business, while Mr. Levi Cofren, their popular agent in New England, has been pulling in good orders in Okonite and other line wires. The K. W. specialties continue to take the market, while the sales for the S. S. Key and Keyless socket has been something unprecedented, over 100,000 being already in use. In my article on the new Worcester station in our issue of December 16th, it should be added that all the wire used in the station was Okonite, and the Pettingell-Andrews Company have been making a specialty of this class of inside station work for some time.

The Economic Electric Manufacturing Co., of Brockton, Mass, are rapidly achieving success with their new incandescent lamps, and are building up a nice business. After January 1st they will have a capacity of 600 lamps a day, and since their commencement in October, they have averaged a manufacture of about 2,000 lamps per week. Amongst recent business, they have received orders from the *New York Herald*, the *Boston Globe*, and the West End Street Railway Co., of Boston. They are also making a specialty of large 75 and 100 c. p. incandescent lamps with double filament which are giving excellent satisfaction.

The Standard Electric Supply Co., of Boston, have just been appointed agents for New England for John A. Roeblings' Sons Company, of Trenton, N. J., representing all wires of their manufacture. They will carry a large stock for immediate shipment of underwriters wire, weatherproof wire, magnet wire, lamp cord, and all sorts of bare wires for telephone and telegraph purposes.

Bridgeport Machine Tool Works, Bridgeport, Conn.—One of the most beautiful illustrated catalogues of machinery which I have ever seen, came to hand recently from the Bridgeport Machine Tool Works, of Bridgeport, of which Mr. E. P. Bullard is the energetic proprietor. The catalogue embraces boxing and turning mills, bolt cutters, chucking machines, compound turrets, lathes of all descriptions, screw machines and tools, shapers, and a host of special machines. The catalogue is neatly printed on very fine paper, is profusely illustrated with the very finest cuts, and is beautifully bound in stiff green cover. It is an ornament to any office, and users of machine tools should at once procure a copy.

WESTERN TRADE NOTES.

The Illinois Electric Material Co., 339–341 Rookey, report continued activity in all branches of their numerous supplies and specialties. They are doing a large and increasing business in poles, and electrical men all over are showing a very strong disposition to have their poles orders accompanied with a good supply of their famous "Canvas-Jacket" line wire to string on them. This wire is meeting with extended adoption by reason of its high insulating qualities, durability and immense resistance to abrasion. They have just taken hold of the various specialties made by the Star Electrix Co., of Philadelphia, and have already booked some nice orders for the same.

The Fort Wayne Electric Co., through their Chicago office, have closed a contract for 740 2,000 candle-power arc lamps of their well-known "Wood" system for Louisville, Ky.

Mr. C. A. Robinson, formerly manager of the Street Railway supply department of the Great Western Electric Supply Co., has joined the forces of the Electric Construction and Repair Co., Springer building, this city, and will handle the many new and valuable electric street railway specialties which this company are now busy manufacturing and will place on the market immediately.

Mr. J. E. Wilson has associated himself with Mr. W. B. Pearson, the Western agent of The Ball Engine Co. of Erie, Pa., and will be located in the Rookery. Mr. Wilson has been for some time past prominently connected with the Western Power Construction Co., and this company having gone out of business, he has seen fit to connect himself with the Ball engine interests. Mr. Wilson has had a long and most extensive experience in mechanical and electrical engineering, having been engaged in this class of business for the past 14 years, and he is a pioneer in many of its branches. He was formerly for a number of years allied with the Bell Telephone Co., of Boston, and later was superintendent of the Financial Telegram Company of that city, which position he filled for five years with the greatest credit to himself and the unbounded satisfaction of the company. When he came West to represent the interests of the McIntosh-Seymour engines, a position for which he was peculiarly fitted by his previous experience, he soon showed his capabilities in this line by the large amount of business which he secured and the number of those excellent engines which he placed. Mr. Pearson and The Ball Engine Co. are to be congratulated on having secured his services, and Mr. Wilson is especially fortunate in being connected with a concern whose engines are so well and widely known.

Mr. D. T. Everts, assistant manager of the Simplex Electrical Co., of Boston, is in town for a short visit.

Mr. G. A. Edward Kohler, Western manager of the Eddy Electric Motor Co., of Windsor, Conn., is going East to Philadelphia for a two-week vacation.

The Electrical Supply Co., of Chicago, is making a special Christmas display of electrical effects and novelties in its Randolph street windows, and it has issued neat little special invitations to its friends to be on hand any evening between 4:30 and 6, to see the show.

Chas. G. Armstrong, some of whose electrical inventions have been illustrated in our columns, has resigned the position of assistant manager for the Great Western Electric Supply Co., and is now turning his attention to contract work. Besides his own devices, he is prepared to install others which have been equally well worked out, and already has contracts under way in some of the largest buildings in Chicago. His wide acquaintance among architects as well as electrical people in the West foretells his success, and his ingenious contrivances will soon find their way into many parts of the country. At present his address is 333 "The Rookery," Chicago.

THE

Electrical Engineer.

VOL. X. DECEMBER 31, 1890. No. 139.

THE INFLUENCE OF POSITION OF COMMUTATION ON THE OUTPUT OF A SHUNT-WOUND DYNAMO WITH SIEMENS "H" ARMATURE.

BY J. MARTIN.

THE dynamo in question is one of a type which has found an extended application in electroplating work, and tests made recently by the writer to determine its capacity at its rated speed of 1,250 revolutions are the basis of the present

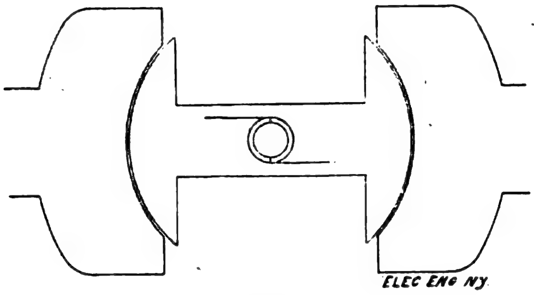


FIG. 1.

article. The field is of the bi-polar type with yoke on top and is made of cast iron, in three pieces.

In the tests the field regulator was short circuited so that

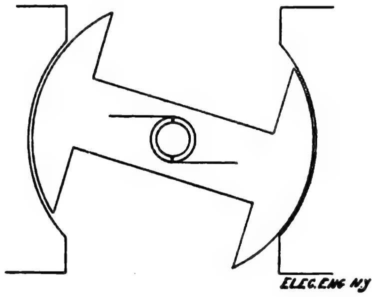


FIG. 2.

the field strength was at all times the maximum attainable under the attendant circumstances. The armature core is composed of twenty-eight wrought iron discs one-eighth of

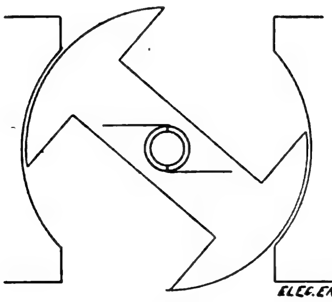


FIG. 3.

an inch thick, with a malleable iron head at each end. The armature winding is in one coil and the commutator has two sections.

In the tests the brushes were fixed in position and the commutator and armature core, which are adjustable relatively to each other, were shifted to the required positions.

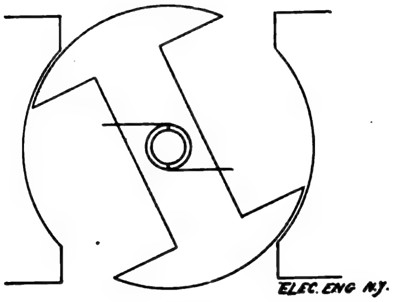


FIG. 4.

In Figs. 1, 2, 3, 4, 5 and 6, the six relative positions of the pole pieces, armature core, commutator and brushes at the time of the brushes leaving one commutator section for the other are shown.

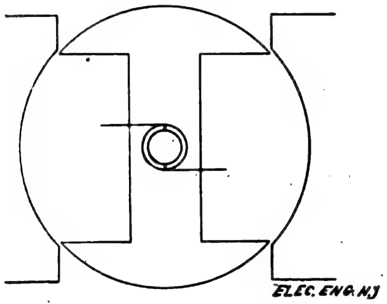


FIG. 5.

Fig. 7 shows the curves (which are numbered according to the positions already shown in Figs. 1 to 6) of the output measured in volts at the binding posts of the dynamo

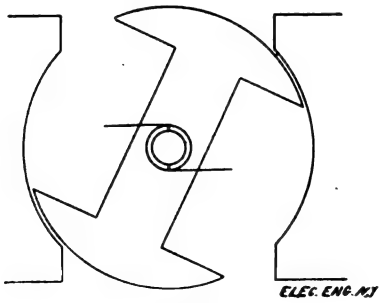


FIG. 6

and amperes in the external circuit, taken on non-inductive resistance.

The curves, 1 R, 2 R, 4 R, are taken on residual magnetism at the positions indicated by their respective numbers. The points on the curves at which the watt output is a maximum is at the centre of the small circles shown. The accompanying table gives the numerical value of this point with the other necessary data.

Position.	Volts at Open Circuit	Speed at same.	Maximum Watts.	Volts at Maximum Watts.	Amperes at Maximum Watts.	Speed.
1	2.08	1,290	39.2	2.8	14	1,290
2	4.3	1,230	71.3	3.1	23	1,240
3	4.32	1,270	89.6	3.2	28	1,260
4	3.65	1,280	102.5	3.04	33.4	1,250
5	2.95	1,290	94.5	2.7	35	1,270
6	.15	1,290				
1 R	2.14	1,320	7	1.4	5	1,320
2 R	3.1	1,320	18.9	2.1	9	1,320
4 R	2.5	1,300	23.4	1.8	13	1,300

As is readily apparent, there is considerable interest attached to the curves on which the following remarks may be made:

Curve 1.—This was taken at the position of theoretical

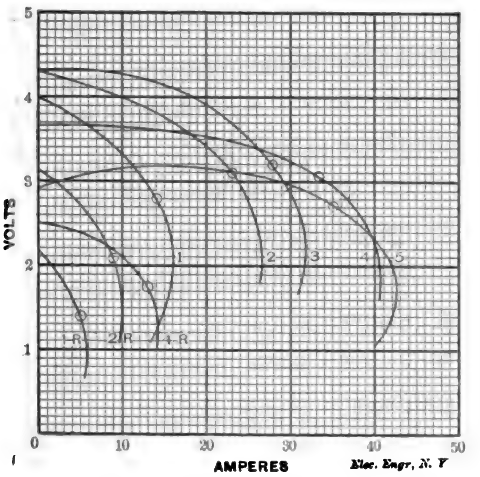


FIG. 7.

commutation. The sparking was excessive at the open circuit reading but decreased as the external current increased, and at 15 amperes was slight. *Curve* 2.—This position nearly coincides with that of highest voltage with

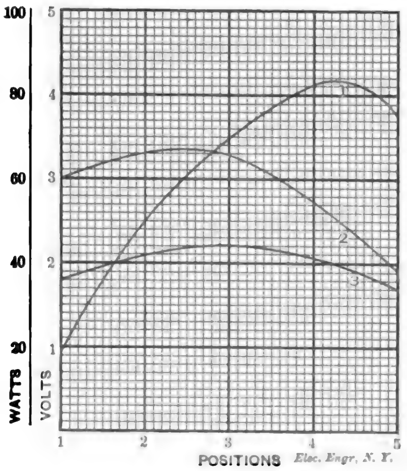


FIG. 8.

a separately excited field and no current flowing in the armature. *Curve* 3.—The sparking was bad at open circuit, followed by a decrease, then increasing and decreasing again to very slight at the maximum current. *Curve* 4.—This curve is specially characterized by an even voltage from 0 to 12 amperes and giving the maximum watt output of the positions tested. The sparking on open circuit was bad; but from 10 amperes to the maximum was slight. *Curve* 5.—We have here the very interesting feature of a decided rise in voltage with current up to 15 amperes dropping even with the initial at 29.5 amperes, at which point the speed had decreased 20 revolutions. The maximum watt output is less than in the preceding position. The sparking was slight at open circuit and was 0 over almost the entire range of current. Position 6 gave .15 volts negative on open circuit, and no further readings were taken on it.

With the idea of possibly getting a more positive effect of the action of the current in the armature, the curves 1 R, 2 R, 4 R, were taken after charging the field for each to the maximum extent obtainable from its own current.

The curves present the same general characteristics as those obtained with the field self-excited at the same positions.

To get an idea of the relative effect of the various positions tested, the curves shown in Fig. 8 were plotted taking positions as abscissas and maximum watts (Curve 1), open circuit volts (Curve 2), and volts at maximum watts (Curve 3) as ordinates.

The maximum positions are for watts, between positions 4 and 5, nearest 4; open circuit volts, between positions 2 and 3; volts at maximum watts at position 3.

THE "THRILL OVER THE WIRE."

BY PATRICK B. DELANY.

I HAVE recently been asked for my opinion on the "thrill over the wire" subject which has been discussed so actively and considerably in the newspapers. My recollection of the cause of this discussion is that a telegrapher relates an experience which he is unable to account for, to the effect that in the performance of his daily work of sending and receiving messages, he has experienced a peculiar "thrill" when working with a certain operator, while his work with the rank and file has been unattended by this pleasing sensation, and, that although this operator who thrilled him was not himself much of an artist in his line, still, whenever he worked the key at the other end, the relator was in a measure put under a spell. Moreover, on one occasion when almost incapacitated for work by illness, the call of this particular operator from the other end of the line infused in him a mysterious vitality which drew him from a sick couch to the instrument and held him there in the performance of his duty until his malady left him. Other operators have come forward and expressed themselves as having been similarly affected by certain affinities or controlling influences over the wires, and without attempting any explanation they simply allege or admit that they have felt the "thrill."

Speculation as to the nature of this mysterious influence runs mainly in the direction of hypnotism, and the question is asked whether or not the hypnotic influence can be sent electrically, or exerted over a wire just as well as though the parties were face to face. In affirmative support of this theory we have from France the statement that the hypnotic influence has been forwarded by mail through the medium of a letter or postal card. We are informed that a young woman having an aching tooth which she was afraid to have pulled on account of the pain, received a communication by mail from a hypnotistic friend several hundred miles away telling her to go to a certain dentist and fall asleep while her tooth was being pulled. She did so, and felt no pain.

Now if I could bring myself to believe this to be true, I would answer the request for my opinion on the "thrill over the wire" by simply telegraphing "Never felt it, but thrill is all right." But I do not believe the tooth yarn, nor do I believe that mesmeric or hypnotic influence can be sent either by post, telegraph or other intermediary. I think the young woman must have deceived herself. Her sleep was probably imaginary, and furthermore,

the operation might not have been painful even though she had not received the letter. I strongly suspect that if the letter had informed her that the dentist would charge her fifteen dollars for pulling the tooth she would have experienced great pain and would not have slept for a week.

Now as to the "thrill over the wire," I have been thinking backward over the many years and wires covered by my own experience as a telegraph operator, looking for "thrills," as it were, but I am unable to join in the liberal corroboration of this operator's experience which his story is said to have brought out. If he had said he was thrilled by a first-class lightning sender, and was able to take the sending, *and put it down*, I would go a long way in his direction, for there is glory in being able to tell a great sender to "go" when he inquires after an hour's silence on your part "r–u–tr ?" But I was never thrilled, like the man who started this discussion, when working with an inferior operator. I have been strongly influenced under such circumstances, but not in the way he describes—rather more in the line of murder. I am sorry for it now, but couldn't help it then.

CURTIS' ELECTRIC RAILWAY CONDUIT.

We frequently hear the remark that while the progress made in electric railroading in this country is very creditable to American electrical engineering and to the enter-

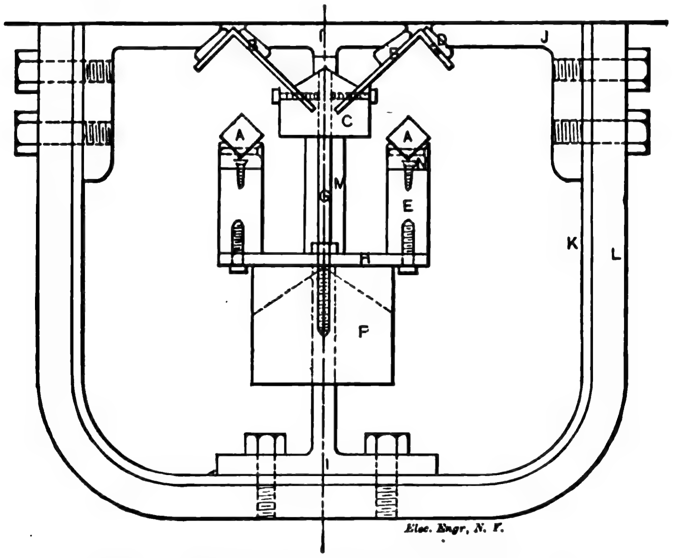


Fig. 1.—Curtis' Electric Railway Conduit.

prise of our railway companies, the time has come when the present methods of construction require some modifications to adapt them to the demands of an exacting public. This applies more particularly to the system of overhead wires now generally employed, but which is likely in the future to interfere seriously with the extension of electric railway work, at least in our largest cities. With this obvious fact in view not a few electrical engineers are wisely devoting their attention to the best methods of leading the current in conductors placed in conduits. The problem is by no means an easy one and involves many difficulties which must be overcome to insure success. Principal among these is the drainage of the conduit and its maintenance free from dirt and other street refuse, while at the same time permitting of making a good contact with the conductors within.

To secure this desideratum Mr. H. N. Curtis, of this city, has recently designed a form of conduit in which the slot through which contact is established from the conductor to the motor on the car is normally maintained closed, and only opened at the point at which the car happens to be at the time. The accompanying engravings show the manner in which this is carried out, Figs. 1 and 2 showing respectively a vertical and longitudinal section of the conduit.

The latter is built up of sheet iron K bolted to the heavy

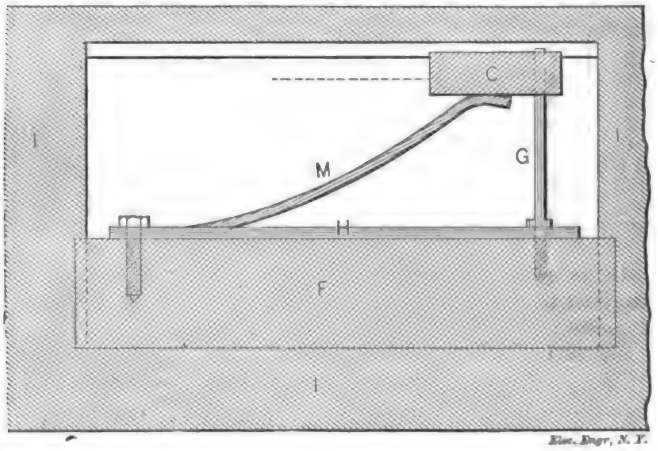


Fig. 2.—Curtis' Electric Railway Conduit.

collars L. In the centre of the conduit there is firmly bolted an I-beam I which reaches to the top and, together with the two angle bars J at the side, serves to form the two slots. The conductors AA, of rectangular form, are supported upon insulating pieces E, screwed to an iron plate.

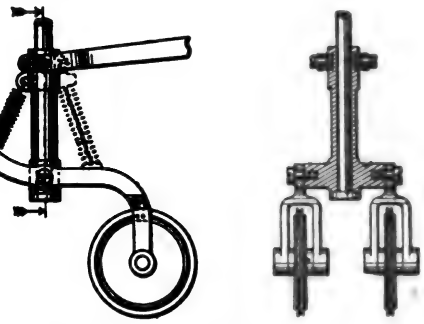


Fig. 3.—Trolley Wheels.

The slots, as will be seen, are closed by angle bars B upon which are fastened rubber strips that effectually seal the conduit and prevent the entrance of water and dirt. These angle bars are fastened in insulating connecting blocks C, which are pressed upward by the spring M, and maintained in a central position by the guide rod G. The bars B are made in lengths of three or four feet and joined together

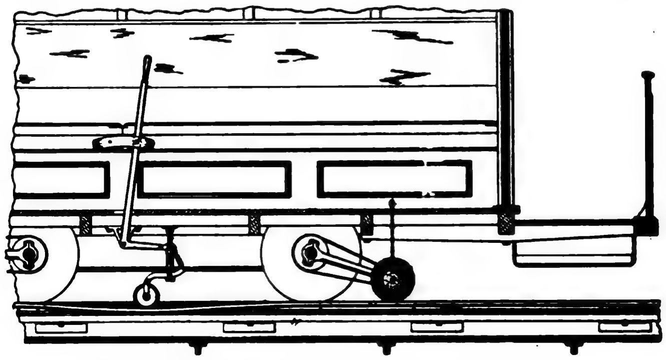


Fig. 4.—Curtis' Electric Railway Conduit.

flexibly so that they form a continuous length which can be depressed.

It will now be readily seen that as the car travels along, the trolley wheels shown in Fig. 3 depress the bars B and bring them in contact with the conductors in the slot, in the manner shown in Fig. 4, the current thus passing from

the conductor through the bars and trolley wheel to the motor on the car.

As soon as the pressure of the trolley wheel is removed, by the passage of the car, the flexible contact strip returns to its normal position by the pressure of the supporting springs by which it is upheld. A rotary brush attached to the car in advance of the trolley wheel clears the contact strip of all foreign material.

The insulating strips which protect the flexible metallic contact strip from the jaws of the conduit slot fit sufficiently close to practically exclude dirt, moisture, and all foreign material from entering the conduit. That which does fall into the conduit, can readily be removed through sewer connections by a brush or by flushing the conduit.

THE COMPARATIVE ECONOMY OF ELECTRIC, HYDRAULIC AND STEAM ELEVATORS.

The erection of high buildings makes the installation of elevators for the transportation of passengers a necessity. The nature of the service is one, however, characterized by such variability in load that the economy obtainable in other power applications had until recently been largely sacrificed to other considerations, when the advent of the electric motor placed in the hands of the engineer, a machine characterized eminently by its qualities of regulating the power consumption to the load.

In order to bring out clearly the relative economy of the electric elevator over the usual types of hydraulic and steam elevators, we give below a discussion of this important question by a well-known steam and mechanical engineer:

The questions which should have influence in making a decision as to elevator service, should be, efficiency, safety, economy of operation, durability and space to be occupied in the building by the operating machinery, and lastly the first cost of the plant.

In all of the elevator machinery as now constructed, the cost of operation so far as coal is concerned is altogether too great, and is in all cases, with the exception of the water-balance elevator, very nearly the same, whether the elevator is carrying its maximum or minimum load. The water-balance elevator is at its best when it has to carry its load from the bottom to the top of the building, without any intermediate stops, and consequently no change of its load during the trip; but even the water-balance elevator under these conditions, which are the very best it can be operated under, consumes twice the amount of power which should be necessary to do the work, as the following statement will show.

Let us consider the water-balance elevator, having a maximum capacity to lift 2,000 lbs. of load, the car and cage will weigh about 2,000 lbs., 1,500 lbs. of which will be counter-balanced. That leaves 2,500 lbs. to be lifted when the maximum load of passengers is in the car; but as the average load carried on passenger elevators is not more than one-quarter the maximum, which in this case would be 500 lbs., then we have for an average load carried during the day, 500 lbs. of passengers and 500 lbs. of counter-balance, and as carrying the counter-balance is so much dead loss, it follows that even the water-balance elevator in its very best condition of work, wastes just one-half of the power. In other words, when it lifts 500 lbs. of passengers, it at the same time has to lift an equal weight of uncounter-balanced car, for which it has no compensation. This is the condition of the water-balance elevator, which so far as the question of economy alone is concerned, is the very best of all the elevators now built.

The next elevator to be considered in economy of coal in its operation, is the direct connected steam machine. Now while it is possible to build a steam engine to run an elevator and use steam in proportion to the load which it has to raise, it is a fact that such an engine has never been built, and, practically, the steam engine driving an elevator uses just as much steam to lift the passengers direct, as it does on the water-balance machine to pump the water and lift the passengers through the agency of hydraulics. Theoretically, from the nature of the contrivances, this should be so, and in practice the results obtained, bear out this statement. But these two machines being considered, one as against the other, the steam machine is to be preferred —first, because it costs less; secondly, it takes less room in the building, and all things considered, it is less liable to accidents which endanger life.

Now, as to the ordinary types of hydraulic machines, whether they be direct lifts or the vertical type of machine, or whether they are of the horizontal type, one feature is common to them all. This feature is, that their consumption of water per trip, and consumption of power to furnish that water, is exactly the same for all loads; that is to say, they use just as much power to carry the elevator boy to the top of the building and bring him down again, as they do to carry the maximum capacity of the machine. The extravagant use of fuel in all this type of machines is something phenomenal, when the work which is done is considered.

If we take the steam from the boiler and follow it to the simple duplex pump, or to the compound duplex pump, we will find in elevator service, that for each actual horse power of water delivered into the tank, whether it be on the roof or the pressure tank in the basement, the enormous quantity of eight pounds of coal is used. Now, after we have got the water into the tank ready for use, we waste four-fifths of this power; one-fifth is thrown away in lifting the uncounter-balanced car, and three-fifths in having to use the maximum of water for all loads, while the average of all loads is but one-quarter of the maximum. These features are, as remarked before, common to all hydraulic elevators.

The steam machine is but a trifle better in economy, for the reasons stated previously, because the back pressure on the piston always rises to correspond with the decrease of pressure upon the steam side. The water-balance elevator uses water in proportion to the load lifted, whenever the loads are brought down at all times equal to those which are carried up, but as a large portion of the trips are made with small loads coming down, and many times with none but the operator on the car, it is necessary to make the counter-balance less than the car by about the average load lifted, so that the water-balance elevator, at its best, uses twice as much power as it should, to accomplish the work.

As to the question of cost of the water-balance elevator, the direct-steam, or the vertical or horizontal hydraulic, they come in order as follows: The cheapest is steam, the next is the water-balance, and the next hydraulic, either vertical or horizontal, which are practically the same.

The amount of *useful room* occupied in the building, is least with the steam; next comes the water-balance; third, the vertical hydraulic, and fourth, the horizontal hydraulic. In considering the room occupied, of course there is taken into account all of the space occupied by cylinders, tanks, pumps, etc.

To produce an elevator which should be reasonably cheap, efficient and safe, and at the same time use power in proportion to the load lifted, has been the dream and study of all principal elevator builders of the world. Such elevators are now built and operated by electricity. An elevator of this type is less in first cost of any, requires less room in the building than any other, and can be operated with less than one-half the amount of coal of any other. The best arrangement possible for an electric elevator is to place the machinery at the top of the elevator shaft above the travel of the car, for the following reasons: First, in that position the machinery occupies no otherwise useful space in the building, and in that situation the machine can be so counter-balanced that the amount of power required at any one time, whether the car is ascending or descending, is only sufficient to move half of the maximum carrying capac-

ity of the car. The same machinery however may be placed at the bottom of the elevator shaft, in the basement, occupying about the same room that an ordinary steam machine does. In either case it will use the power in proportion to the load carried.

In order to make this statement clear, as to the economy of the electric elevator when compared with the hydraulic, it is necessary to show where the power is lost in each case, and where the difference lies. First, the duplex steam pump, uses eight pounds per hour for each horse power; the engine which drives the dynamo to furnish electricity uses at most four pounds. Only one-fifth of the power developed in the steam pump is utilized in lifting passengers. In the electric, three-quarters of all the power which is developed by the driving engine is used for operating the elevator; besides, in all large buildings there are electric lights, and electricity is used for various purposes, and must have an electric generator in any event.

As to the question of safety, with all these various types of elevators (leaving out the water-balance), there is practically no difference. The safety appliances which are on one machine, may be applied to any or all.

A PRACTICAL GUIDE TO THE TESTING OF INSULATED WIRES AND CABLES.—VII.

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BY HERBERT LAWS WEBB.

CONDENSERS.

In comparing small capacities, such as those of over-head lines or short lengths of underground cable, it is a great convenience to be able to adjust the standard condenser to give about the same deflection as the wire or cable to be measured, and the accuracy of the test is also greater than if widely different deflections are obtained. The convenience, therefore, of employing an adjustable condenser, the sections of which can be connected either in parallel or in series, is obvious.

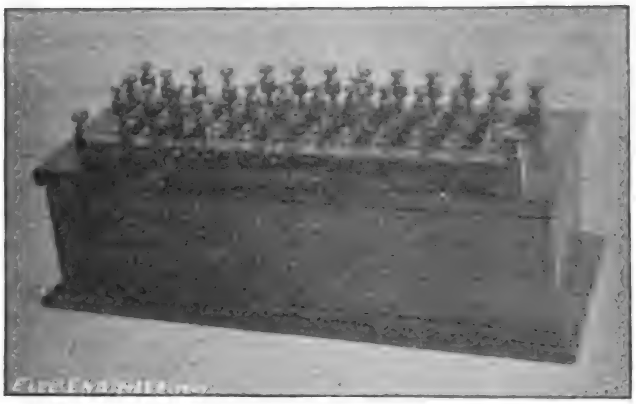


Fig. 24.—Condenser For Testing.

Fig. 24 illustrates a condenser having a total capacity of 4 microfarads and a range of capacities from .00985 microfarad up to the limit. This condenser has twelve sections; one of 2 microfarads, one of 1 microfarad, and ten of one-tenth each. The alternate plates of each section are connected to small brass blocks, insulated from the long strips running the full length of the condenser; the plugs are provided with small binding screws, and for connecting the sections in series they are inserted in the holes in the blocks and connected diagonally with short pieces of wire, the two end blocks of the series being plugged to the long strips so as to make connection with the discharge key and earth.

In Fig. 25 an improved form of the multiple series adjustable condenser is shown. The blocks are arranged so as to overlap each other, and the different sections can be joined in series by means of the plugs alone without the use of connecting wires. The plugs are fitted with binding screws so that the different sections can be used as separate condensers if desired, each section being rendered independent of the others by connecting wires to the plugs and inserting them in the blocks. This instrument is the *ne plus ultra* of adjustable standard condensers; the style illustrated is divided into five sections of one-tenth each, and has a range of capacities from .02 microfarad to .5 microfarad.

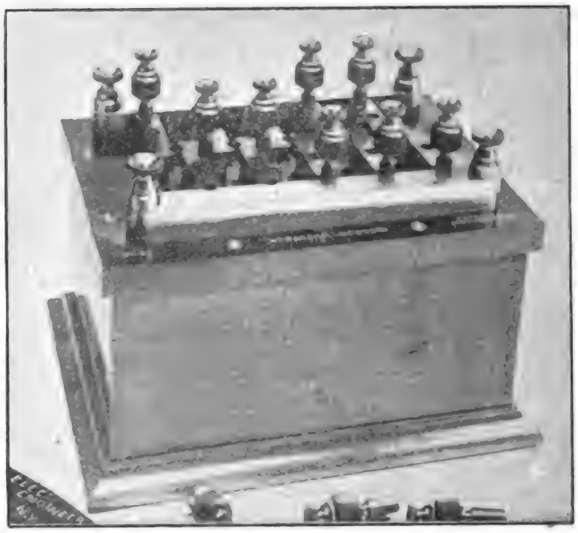


Fig. 25.—Improved Multiple Series Adjustable Condenser.

When not in use, standard condensers should always be short-circuited by inserting the plugs between the brass blocks to which the plates are connected; in this manner any residual charge is neutralized.

TESTING BATTERIES.

For testing purposes a battery of at least 100 cells is necessary, and in cable factories it is customary to use 200, or even as many as 500.

A set of accumulators form an ideal battery for testing, but a large number of secondary cells is seldom available. The next best is some form of Daniell, either the origina Daniell or the Minotto, but not the ordinary gravity batteries, as the solutions in these cells diffuse quickly unless the battery is doing constant work. In many cases Leclanché cells are used for testing batteries and answer very well, as they require very little attention.

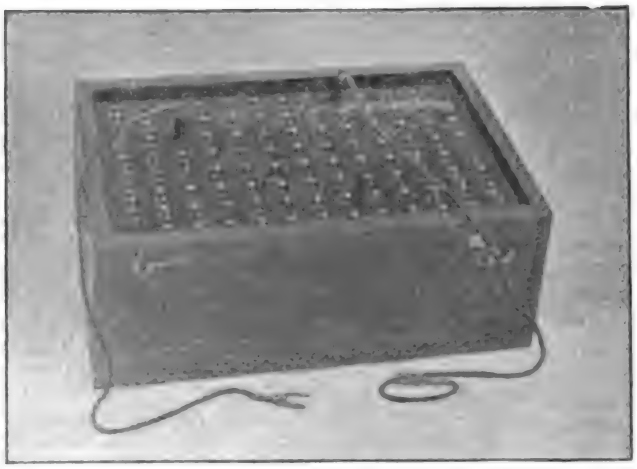


Fig. 26.—Chloride of Silver Battery—100 Cells.

The battery most frequently used for testing work in this country is the chloride of silver cell, made up in sets of 50 or 100. This battery has great advantages over all others in point of compactness and portability, and the ease with which any number of cells may be connected. The chloride of silver cells require very careful handling to keep them in good order, as, if the battery is worked on a low resistance, or short-circuited, several damaged cells will probably be the result. As portable testing sets do not always receive the most careful handling, these batteries frequently need the attention of the manufacturers to keep them up to the mark. The cells have a pretty high internal resistance to start with, and this increases with time, mounting up sometimes to an alarming figure.

The small commutator usually provided with the portable testing batteries should never be used. It is a most unsatisfactory and vexatious instrument, always working loose and making bad contact; or, if screwed up tight, metal dust is ground off the points and distributed over the plate so as to partially short-circuit the battery. It is somewhat surprising that the manufacturers of the batteries should still cling to this very inefficient style of reverser.

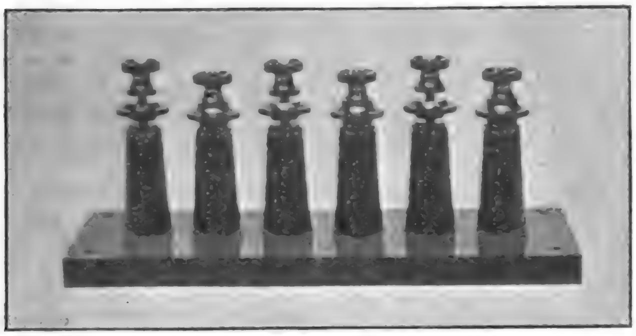


FIG. 27.—INSULATED DOUBLE BINDING POSTS.

In Fig. 26 is illustrated a 100 cell chloride of silver battery. The fixed commutator is discarded and the connecting cords are provided with forked tips by means of which they can be connected to a battery reversing key of proper design (such as that shown in Fig. 14). The cover of the case is made entirely removable instead of being hinged, this arrangement being more convenient for work in a permanently fitted up testing room.

The testing battery should be placed in a well protected situation so that it may be kept free from dust and dirt, and above all the entire battery should be thoroughly well insulated, as a badly insulated battery will disorganize the work and render the tests valueless. If Daniell or Leclanché cells are used they should be placed on wooden stands raised from the floor or shelving by means of hard rubber feet about four inches long; the cells should be well separated from each other and the glass jars should be kept dry and clean; they should be frequently inspected and any incipient signs of "creeping" must be attended to at once. It is of great importance in testing that the battery shall be perfectly constant; any slight defect in the battery will affect its constancy and neutralize the value of the tests. Therefore, too great care cannot be taken in avoiding the appearance of any such trouble, or in remedying it after the slightest indication of its existence.

In a testing battery the cells are of course always connected all in series, as for insulation tests the full E. M. F. is generally required. In measuring conductor resistance and electrostatic capacity it is only necessary to use from five to ten cells. With the chloride of silver battery it is a very easy matter to connect any desired number of cells to the battery reverser, as one pole of each cell terminates in a small nipple on which the plugs of the connecting cords fit tightly, and in order to vary the number of cells the only operation necessary is to alter the position of one of the plugs. With a battery composed of 100 Leclanché cells permanently connected in series, the question of changing the battery power quickly is not so simple, involving the connection of wires, which is rendered additionally troublesome when the battery, as is generally the case, is placed in a more or less inaccessible position.

The best plan of getting round this difficulty is to provide a number of insulated binding posts on the testing table to which wires from the battery may be permanently connected; it is then an easy matter to join up the battery key with the number of cells required for any particular test.

Let us assume that we have a battery of 100 cells. To the testing table, or to the wall at the side, or in any position that may be most convenient and accessible, is screwed a set of double binding posts mounted on hard rubber pillars and base. To the binding post number one a wire is run from the zinc pole of the battery and the carbon pole is connected to post number six; to the intermediate posts wires should be run from the carbon poles of the first, fifth, tenth and twentieth cells. One terminal of the battery reversing key being connected to the zinc binding post, it is an easy matter to connect the other terminal of the key so as to obtain battery power of one, five, ten, twenty, or the full number of cells, by simply changing one wire. These combinations of cells are all that will be required for general testing, and the connections from the battery to the pillar binding posts once made, the battery need never be touched except for inspection or removal of defective cells.

A set of insulated double binding posts suitable for making the battery connections described above is shown in Fig. 27.

The testing room is generally some distance from the terminals of the cables to be tested, or, in a factory, from the tanks in which the wires and cables are submerged. This separation, however inconvenient, is necessary in order to secure quietness and freedom from magnetic and mechanical disturbances likely to affect the steadiness of the galvanometer.

In order to make connection with the cables to be tested, a number of permanent leads, which should be of the best possible description, heavily insulated and well protected from mechanical injury, are run from the testing room to the terminal room or cable-tanks. It is best to terminate these leads at the testing table on a set of the insulated double binding posts described above; the ends of the leads are then protected from damage and the insulation afforded is excellent; the pillars can be numbered to avoid confusion and any lead can be connected with the testing instruments by simply joining a short piece of wire from the key to the binding post on which the lead required terminates.

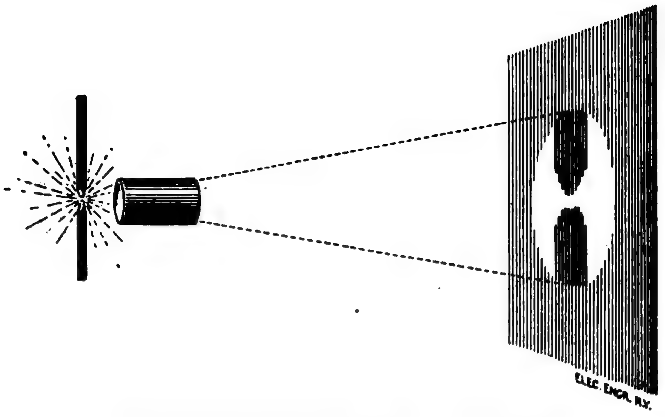
TELEPHONE WORK IN JAPAN.

Many of our readers will remember the visit to this country from Japan of Mr. S. Oi, a Japanese electrical engineer. In a recent letter to Mr. G. M. Phelps, he says: "Since my return from America, I have been entrusted with the whole affairs relating to the establishment of telephone exchanges in Tokio and Yokohama. We don't have many subscribers at present, but as far as I can see, the exchange is getting more and more popular and we have many applications in succession day after day. We opened the exchange here in Tokio, about a month ago. The annual subscription is about $32 in Tokio and $28 in Yokohama anywhere within the limits of the towns. As there is no need of using multiple switchboards at present, we use an ordinary type of switchboard made here in Tokio. We use conductors of No. 18 hard copper. That I have been enabled to finish the exchanges successfully is principally due to the kind assistance I had received in the States in making investigations in the various exchanges." Mr. Oi adds that Mr. Sawai, an electrical engineer who is also well known in this country, has been ill and is at present ruralizing 400 miles from Tokio for the recovery of his health. Mr. Oi is now attached to the Department of Communications of the Telegraph Bureau.

TESTING ARC LAMPS.

BY FRED. H. COLVIN.

There is in use at the main Brush Electric Light Station, Philadelphia, an ingenious and praiseworthy arrangement for testing the arc lamps before they are sent out, or on repair work. It is praiseworthy because it saves the



Simple Method of Testing Arc Lamps.

eyes of the workman and ingenious because of its novelty.

The testing rack is of the usual form, but in front of each lamp is placed a lens which is provided with a rack and pinion focussing arrangement, and fitted in a horizontal sliding way or frame so as to be readily adapted to each carbon.

The lamps to be tested are switched on as usual, but the operator, instead of watching the carbon points themselves, adjusts the lens to focus on the white wall several feet away, and there watches the enlarged and inverted image of the carbons in all their processes of burning, and sees much more accurately than if he watched the carbons themselves. This does not injure the sight to any perceptible degree, and is not only humanitarian, but gives a clearer idea of the action of the carbons.

The accompanying figure will illustrate the plan quite clearly.

SABOLD'S GROUND CIRCUIT FOR ELECTRIC RAILWAYS.

The experience thus far gained in electric railroading has shown that too much attention cannot be given to the integrity of the ground or return circuit, and our columns have already contained numerous descriptions of devices and arrangements designed to effect this purpose.

The cheapest form of construction, which is, of course,

Sabold's Earth Return for Electric Railways.

the most unreliable in operation, is that in which the track-rail alone is depended upon as a return conductor. This system is found only on suburban roads where the traffic is so light as not to warrant the addition of supplemental wires, which are laid on more important roads at considerable expense.

But even in the latter case, the result of practice has shown that in numerous cases the ground wires have been rapidly attacked and reduced in effective section by corrosion, due largely in all probability, to electrolytic action.

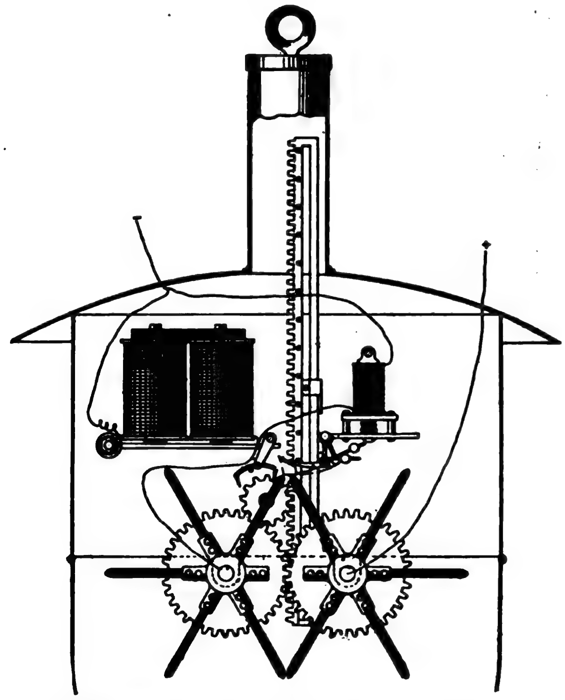
To this must be added the fact that in numerous cases the single trolley system of operating electric railways has given rise to grave troubles in telephone circuits located not only in proximity to the car line circuits, but even in those situated at a considerable distance. Investigation soon showed that this was due not so much to induction between wire and wire, as to an actual leakage by conduction; the railway current, notwithstanding the return wires, escaping to ground and seeking other convenient paths, such as the telephone wires, in returning to the dynamo at the generating station.

To afford an effective return circuit for the current and at the same time to avoid interference with telephone circuits, Mr. F. W. Sabold, of Albany, N. Y., has designed and recently patented a system which is now in successful operation on the lines of the Albany Railway Co., as well as in Troy, N. Y., and the work of equipping the Watervliet railway, extending from Troy to Albany, is now being carried out. In all these places the interference with the telephone service was so serious as to make the telephone practically useless, but the introduction of Mr. Sabold's system has remedied the trouble.

The method employed is exceedingly simple and consists, in the first place, in relying on the earth entirely as the return circuit; and in the second place, in connecting each rail directly to earth. The plan adopted by Mr. Sabold is shown in the accompanying engraving. As will be seen, each rail is connected by a conductor with an iron rod driven into the ground to a depth at which moisture is constantly present. As the car moves along the track, the current finds at every rail a good ground, and thus has no tendency to take up other indirect paths to reach the generating dynamo. It will be noted also that with this construction the bonding of the rails is of minor importance, and, as no return ground wire is required, the expense of the equipment is greatly reduced.

HENDERSON'S MULTIPLE CARBON ARC LAMP.

The cost of trimming arc lamps was very early recognized to involve a not inconsiderable part of the total operating expense in arc lighting, and to this fact the creation



Henderson's Multiple Carbon Arc Lamp.

of the double carbon lamp is due. But even the saving effected by the latter has not deterred inventors from seeking to still further increase the intervals during which the arc lamp may remain without attendance and has given rise to various forms of carbons and devices for prolonging

their life. Still another method which has lately been brought out consists in providing a number of sets of carbons, each of which is successively brought into action, as its predecessor is consumed.

A lamp based upon this principle and recently patented by Mr. W. B. Henderson, of Crafton, Pa., is shown in the accompanying engraving. The inventor, it will be noted, employs six pairs of carbons, mounted on two hubs which are controlled by the lamp mechanism. Each pair of carbons starts into operation at an angular position and as they burn away the hubs are revolved so as to bring the points towards each other; so that when fully consumed the carbons are exactly in a horizontal position. When this point is reached, the mechanism automatically brings the succeeding pair of carbons into circuit and this operation is continued until all the carbons are consumed.

TIGHT BELTS.

BY ROBERT GRIMSHAW.

This is not to be an article advocating tight belts; rather one upon the tightness of belts, and complaining that belts are more often too tight for their good and for that of the shafts which they connect, than too loose. I suppose that about as good a heading might have been "Tight Lacing," the only objection to it being that there are so many other methods of fastening now-a-days than lacing, and that many belts are made endless.

It is usually set down in text books, and in ninety-nine cases in a hundred in the "experience boxes" of men who call themselves practical, that the tighter a belt is (other things being equal) the more it will drive. I had the honor of being the first, so far as I know, to point out that this was true only to a certain extent; that there was a limit, with each kind of belt and each set of conditions, beyond which further tightening not only gave no further increase of driving, but actually lessened the capacity of the belt —to say nothing of the injurious effect upon belt, fastenings, and shaft bearings.

What is that "slipping point," beyond which no further tightening will give more driving power? And why does it exist?

We had better answer the second question first. We know that the tendency of the pull on a belt is to bed it down to the face of the pulley, thus bringing more and more of the surface in contact with the pulley face, according as the tension is made greater and greater. A belt that is soft and flexible will, of course, bed down better than one which is hard and stiff; a surface which is not deformed by rivets will bed down better than one which is not smooth and flat. The effect of bedding a soft surface down to the pulley face is to change its character. A surface which is comparatively porous, or rough, becomes smooth by the pressure, and with some kinds of belts takes on a sort of a glaze—only temporary in some cases, permanent in others. A glazed surface will not drive so well as one which is unglazed; and more harm may be done by glazing the surface, either temporarily or permanently, than can be balanced by the advantage of having the belt touch the pulley all over its surface. In other words, if before excessive tension was resorted to, the belt touched the pulley with three-fourths of its surface, and if after excessive tension was put on, it touched over the whole surface, we would expect one-third increase in the driving power, as a maximum. But if the character of the three-fourths which touched the pulley before straining, is so changed that each square inch of it is only as good as one-half square inch was before, we have the value of the three-fourths lessened to three-eighths, and this plus the new one-fourth which we will assume is as good as any equal portion of the three-fourths, makes only five-eighths, which is not as much as three-fourths.

This is the theory of the thing, and it is simply borne out by tests made in a belt-testing machine and by experience with belts running in saw-mills, electric light plants and other establishments. It is more so with leather belts than with raw hide; more so with leather and raw hide than with cotton, and more so with cotton than with rubber. At least, this is the general run of things. There are exceptional cases where the order in which these belts are affected by excessive strain, is varied; but in all cases the fact remains, that there is a point beyond which further straining not only does not give further driving power, but actually lessens it—to say nothing of the injury to belt, to fastenings and to bearings.

The moral of all this is to run your belts loosely; then you will be sure that you are not hurting them, while at the same time lessening their driving power. So long as a belt will start its driven pulley suddenly, it is tight enough for the work. It may be tight enough to run the job right along and yet not be able to start a machine from a state of absolute rest; particularly if there be heavy rotating parts which absorb power during quiet running, to give it out when needed to overcome a sudden excess of load.

Of course I do not mean that a belt should be run so loose that it would flap and weave; but so long as it runs quietly and without slinging from side to side, it should be allowed to be as loose as it can be slacked up to, and yet drive the load. And if there be a flapping fold running from the driving to the driven side, it is much better to take it up by an idler pulley near the smaller of the two pulleys connected by the belt, than to take up the slack at the fastening.

Idler pulleys are great things if people will only distinguish between them and tighteners. An idler should in no way increase the strain at the fastenings; should in no way increase the pull on the bearings; that is the test. The minute that it does this it is not an idler, but a worker, and a mischievous worker at that. The proper way to apply an idler is so that it will increase the wrap on the pulley on which the belt drives the most poorly. (This is not necessarily the smaller of the two pulleys, for sometimes a small wood pulley will have more grip upon a belt than a large one of iron; sometimes a small iron pulley may be lagged with leather or paper so as to drive better than the larger one over which the belt runs.)

Of all the ways by which a belt may be made to drive more, giving it greater tension may be regarded as the poorest all around. Give it more arc of contact; give it better pulley surface, run it faster—do almost anything except increase its tension. Of course, increase of width or of thickness gives increase of driving power under similar circumstances, but that means another belt, and should not be resorted to so long as the simple means of giving more arc of contact, better surface to grip on, and greater speed, remain untried.

MR. MACKAY'S IDEA OF CHRISTMAS.

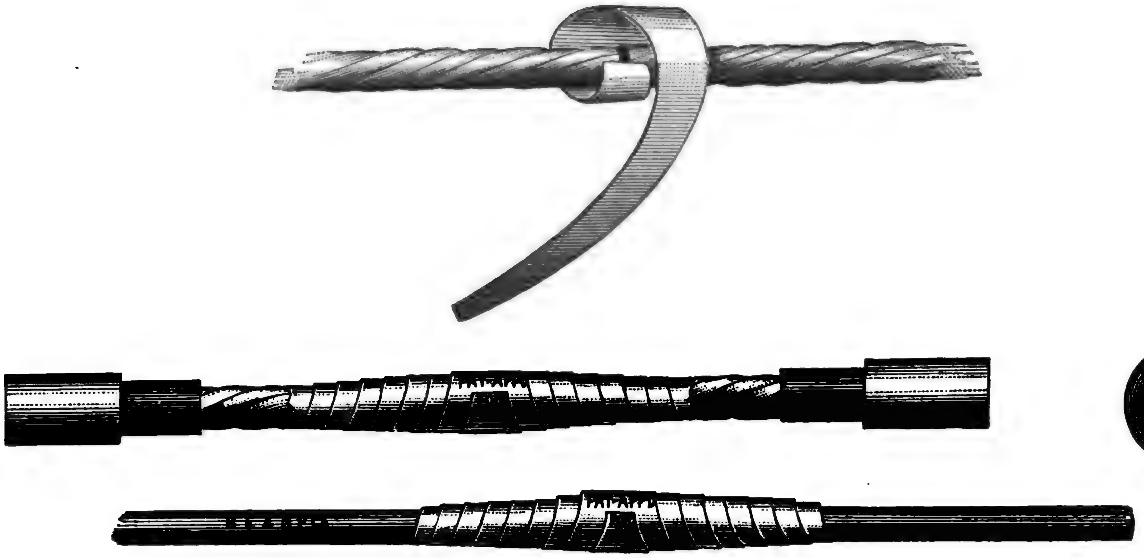
Mr. John W. Mackay, following a generous custom that he set some years ago, has again authorized General Manager Ward to give every employee of the Commercial Cable Co. in this country and in Europe, half a month's salary as a Christmas present.

ELECTRIC LIGHTING IN NEW YORK CITY.

Within a short period electricity will again take the place of gas for street lighting purposes in the districts where the electrical subways are laid. The electric light companies have held out for several months for forty-three cents a night for each arc light, but in accordance with an informal agreement with the city authorities they have decided to accept forty cents. Before Commissioner Gilroy's onslaught on the poles and wires began there were 1,275 arc lamps in use, for each of which the city was paying thirty-five cents. At present there are about 800 lights in use, for which the old price is still paid. The city has been willing to pay this figure all along, but forty-three cents has been considered entirely too high. The figure which has been agreed upon is the result of a compromise, and 250 old lamps will be lit up again in addition as the result of it.

BERGMANN'S NEW CONNECTOR FOR ELECTRICAL CONDUCTORS.

NEXT to the quality of the conductor itself the most important part of an electric circuit is the joint by which its various lengths are connected to form the complete lines. In all classes of electric work the joint has been found to exercise a not inconsiderable influence on the working efficiency, and as a result we find that constant efforts are being made to improve not only the quality but the ease of accomplishing the union of two ends of a conductor. A good joint should have two important attributes, namely, a conductivity and a tensile strength at least equal to that of the rest of the circuit.



FIGS. 1, 2, 3 AND 4.—BERGMANN'S CONNECTOR FOR ELECTRIC WIRES.

To combine both of these merits with facility in making the joint, the Bergmann Electric & Gas Fixture Co., of this city, have just brought out a unique connector which is specially adapted to the jointing of heavy wires, such as those employed in electric lighting, railway and welding conductors.

The connector employed for this purpose consists simply of a strip of No. 34 sheet copper tinned on both sides, made in various widths and lengths, tapering at one end to about 1½ to 2 inches in width and also slightly tapering towards the other end. The manner of its application is illustrated in Fig. 1, which shows a stranded cable about to be wrapped, Fig. 2 showing the completed joint and Fig. 3 a section of the same. Fig. 4 shows the connector as applied to a solid wire.

In order to make the joint conveniently and rapidly, use is made of a simple clamp stand, which is illustrated in Fig. 5.

The two ends of the cable or conductors to be joined are tightly clamped in the jaws on the stand and the ends brought to within about $\frac{1}{16}$ inch of each other; the handle in the middle of the stand then being given a turn the two ends are brought up close to each other. Then by means of a soldering iron or torch, one end of the copper strip is soldered to the cable and the strip wrapped tightly around the cable ends, acid being applied to each layer. The end of the strap is then bound together by iron wires, about $\frac{3}{4}$ of an inch apart. The whole connector and cable ends are then heated with a good flame and solder applied, after which the iron wires are removed, leaving a perfect joint.

It will be readily seen that the conductivity of a joint made in this manner is fully as great as, if not greater than, that of the conductor itself, and in order to demonstrate its mechanical strength we give below the results of tests made at Columbia College on samples of a No. 2 silicon bronze wire having an area of .043 sq. in :

	Breaking Stress.	Area of Complete Joint before Fracture.	Diam. of Joint.
No. 1	2,140 lbs	.169 sq. in.	.465 in.
No. 2	2,080 "	.165 " "	.459 "
No. 3	2,800 "	.155 " "	.445 "

The normal breaking stress of the wire was 3,490 lbs.

It will be noticed that the connector increases the diamete, but comparatively little at the joint, which is of special importance in insulated conductors. On the other hand the connector is admirably adapted to overhead trolley lines, the joint being perfectly smooth and round and presenting no obstacle whatever to the passage of the trolley wheel.

Another practical convenience, we need only add, is that the connector can be applied to any size or style of cable or bar without requiring a special size of connector for each variation in the diameter of the conductor.

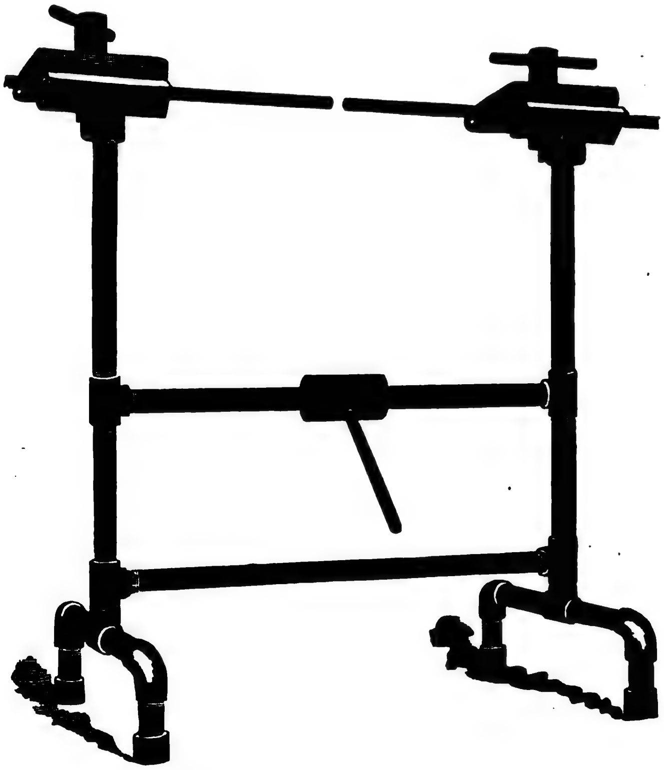


FIG. 5.—THE CLAMPING STAND.

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EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, *150 Broadway, New York city.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers*

VOL. X. NEW YORK, DECEMBER 31, 1890. No. 139

Science teaches us to deduce principles carefully, to hold them firmly, or to suspend judgment, to discover and obey law, and to be bold in applying to the greatest what we know of the smallest. —Faraday.

PREPARING FOR THE WORLD'S FAIR.

PRESIDENT HARRISON has at last issued his proclamation and invitation regarding the Columbus Fair, and the preliminaries appear to be settled, although we question whether anybody outside of Chicago can give a clear statement of the situation, so confused has it become through prolonged jangling and discussion. It cannot be said, moreover, that Mr. Harrison's attitude is a particularly happy or pleasing one, holding out to the nations as he does an expression of brotherly good will in one hand and the McKinley tariff in the other. In view of the fact that the Exposition is to be held so far from either seaboard, it was desirable that, in order to make it international, as few difficulties should be placed in the way of foreign exhibitors as possible, but the latest piece of legislation looks just as though its authors owed Chicago a grudge and were paying it off by trying to keep European exhibitors away.

Still Chicago is a city of great resources, abundant wealth, high courage, and indomitable perseverance, and we expect to see her make a grand success of the Exposition, even though it be narrowed down to a National Fair. If foreigners do not come to show us what they can do, they will at least come to see what we can do and to make acquaintance with the infinite opportunities presented by this country for the investment of capital and the settlement of population. If Europe were to have a Fair limited to its own productions, it would certainly suffice as evidence of the progress of mankind in the arts and sciences; and to-day, the same thing may fairly be said of America, young as it is and with large portions of its soil still unpeopled and in the virgin state. If each American industry and each American commonwealth will but do its duty, the Fair of 1893 will be all that the most patriotic and most enthusiastic of us could wish.

An inquiry has just been addressed to electrical firms and companies, by President Davis, of the Fair, asking them to say how much space they are likely to want. The response to this will not be binding but will indicate approximately, it is thought, the area required for the electrical exhibits. We trust that the answers will be made as fully and as promptly as possible, but we are afraid that there will be some slackness, not for want of interest, but because the necessity for reply does not seem immediate and because the appeal is not direct and personal. It would have been better if an authorized commissioner had received orders to call upon the various electrical concerns in each city and had then made a report of the result. It would also, perhaps, have been better if people knew the name of the official who is to have the charge and direction of the electrical exhibits. We say this, not at all to be critical, but because we are extremely anxious that the electrical section should be one of the largest and most striking, particularly in the matters of light and power. The Exposition should be wholly lighted by electricity, it should be wholly driven by electric power, and this means the early making of comprehensive plans by competent men.

ELECTRIC RAILWAY IMPROVEMENTS.

SIMPLE as the electric railway is in principle, the details of the methods now employed and approved require the most exacting attention in order to insure success, and that our inventors are keeping pace with the demand for improvements in this branch will become evident upon a perusal of our patent record each week. While formerly electric lighting and methods of distribution claimed the largest share of the patents issued we now find the patents on electric railways exceeding by far in number those in any other branch of applied electricity. Among the details of this work, the railway conduit claims a good share of attention, and deservedly so. There is to-day no more important problem to be worked out, than the providing of a suitable method of conducting the current from generator to car without the use of overhead wires. Thus far no systematic and determined attempt to carry out, and operate, despite initial discouragement, such a method of construction on a working line has been made in this country; but those who have been foremost in placing the electric railway where we find it to-day can assuredly be counted upon to meet every further demand as it arises, and though its solution be tardy, we are none the less sanguine that this conduit problem will be satisfactorily solved and at a very early date. The conditions to be fulfilled by a conduit system are exacting in the extreme and are aggravated to a great extent by the character of the streets in new and rapidly growing cities. As one solution of the problem, the system proposed by Mr. H. N. Curtis and described on another page will, we are sure, prove of interest, as embodying features which not only overcome most of the difficulties met with, but which allow of simple

methods of construction. It is evident that if the conduit can be maintained practically clear of extraneous matter, the removal of the latter becomes a question of secondary importance, and it is upon these lines that the conduit problem seems likely to be studied out to a successful demonstration on some large road. In this issue mention is made of the fact that a million dollar cable plant at Grand Rapids, Mich., is to be abandoned as such, and the trackway converted into an overhead electric system. Now it seems to us that the cable conduit thus vacated presents an opportunity to try some such promising system as the Wheless, lately described in our columns, the Harding, or the Curtis, now brought to notice. It seems to us also that the local street railway people would themselves have special interest in such a utilization of their old cable conduit, and in seeing whether, after all, they could not get along profitably without the overhead wires.

THE SIEMENS "H" ARMATURE.

The development of the original type of the Siemens "H" armature into that of the modern type with many commutator segments has relegated the consideration of the former to the background, but there are still some applications of the old type of armature, as, for instance, the telephone magneto call of which in the aggregate hundreds of thousands are in daily use and the number of which is constantly increasing. The results of some tests made upon a machine having this type of armature to determine the influence of the point of commutation, as detailed by Mr. J. Martin, in this issue, show that the efficiency and output can be considerably increased by proper attention to this matter. A little reflection on the subject must make it apparent that the distortion of the field produced by a two-pole armature shifts the point of commutation considerably from its theoretical position. Of course, this point is largely dependent upon the relative strengths of the field and armature and must vary in each case, but it is well to have attention drawn to a phenomenon involved in the daily operation of many instruments.

MODERN ELECTRICAL SUPERSTITIONS.

In his usual shrewd and humorous way, Mr. P. B. Delany discusses this week the stories that have lately been going the rounds of the newspapers about "the thrill over the wire" that one operator is supposed to be able to give another who happens to be sensitive to his mediumistic influence. The best way to treat such beliefs is to subject them to this kind of mild ridicule. It is only strange that they survive and "bob up serenely" time after time, first in one shape then in another. In the present instance, as proof of the statements made, the Charcot hypnotic experiments with magnets have been cited. The fact has been overlooked that Dr. Charcot repeated his experiments with dummy magnets of wood, and, as might have been expected, got exactly the same results. The fact has also been overlooked that Sir William Thomson demonstrated that even when the human body was subjected to a most intense magnetic field, no effect was obtainable, the person under treatment not knowing when the magnet, between whose ends his head was placed, was energized or when it was not. But the credulous victims of this kind of yarn do not care much for fact, it is fiction they are after; and they are very much of the same calibre as the other people who put arc carbon tips in their pockets as a cure for ague or ride in the electric cars to get rid of their rheumatism.

ELECTRIC CARS AND THE SNOWSTORMS.

The late unusually heavy snow storms have been very trying to the street car lines, but on the whole the electric cars have come through the ordeal very well, especially where the management of the road had been wise enough to include snow plows and sweepers in the equipment. Of course, in some places, the cars had to stop running, the deep snow obliterating the tracks for a while, but as other means of travel underwent stoppage also, including steam locomotion, the fact is not at all to their disadvantage. Besides, the point has been emphasized in more than one city, that while the horses were "eating their heads off" during the blockade, the electric plant, if shut down, was on a very economical basis and if in part operation was generating power in exact proportion to the demand for it. Another point brought out by the visitation has been that the single trolley roads have stood up much better than the double. It is reported that in Cincinnati the short circuiting on the double trolley road played havoc with the motors. It really looks as though the single trolley advocates had now carried the day most decisively.

ELECTRICITY FROM WIND POWER.

From the very moment that the storage battery became a practical, commercial apparatus its application to the storage of energy derived from the power of the wind was broached, but up to the present time very few attempts have been made to carry out the suggestion in practice. Our readers will therefore have been interested in the description given last week of the plant operated by Mr. C. F. Brush, for several years at Cleveland, O. When we consider the widespread application of wind power to the operation of pumps for elevating water it seems indeed strange that no determined effort has been made to apply the same power to the storage of electrical energy. In the latitude in which we live steady winds may be counted on for the largest part of the year, so that the only remaining objection would be the cost of a windmill storage plant. We can readily conceive that a single pioneer plant, such as that of Mr. Brush, might involve considerably more expense than a second or third of the same nature, and, again, that the average plant would not require to be nearly as large. It therefore seems pertinent to suggest that this field so entirely unoccupied at the present time be seriously considered, as we are certain that a profitable if not a large business can be developed in this direction.

Electricity is already utilizing thousands of horse power from water courses, and is preparing for even more extensive work at Niagara, and there seems no good reason why it should not utilize the wind. We hear of plans now and then for getting something electrically out of the sunshine and the tides, but while that may be a remote result, it should be easy enough to transform the power of rising winds and falling waters.

THE IMPROVED GRAMOPHONE.[1]

BY EMILE BERLINER.

It might seem strange to you at first that I should commence discussing the gramophone by talking about induction; but I would like to refer to a small portion of a paper which I read before the Franklin Institute in 1888 on the gramophone, when it was first shown, in which occurs the following:

"In my telephonic studies I had become familiar with all the causes influencing the transmission and reproduction of the voice, and what had at all times struck me as forcibly as anything in telephonic phenomena was the fact that the self-induction of long iron wires or of polarized electro-magnets acted so detrimentally upon the articulation. Electric resistance alone would simply have weakened the sound, but self-induction meant retardation and thus distortion of the transmitted waves which varied in length and amplitude."

And further on:

"In considering such and other facts it became evident to me, that if such delicate energy as the voice, subdivided into, maybe,

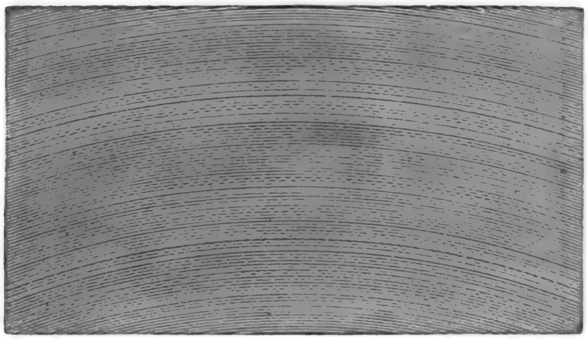


Fig. 1.—Gramophone Record.

several hundred waves should indent or engrave itself into a solid body, it needed but very slight mechanical resistance to modify considerably the character of the sound vibrations, for what self-induction is to the telephone circuit, the variable resistance which impressible material offers to indentation or engraving at various depths is to the phonograph record sheet. Neither is proportional in direct ratio to the expended energy, and must give cause, aside from a reduction in size of the sound characters, also to a distortion of the same."

And that brings me right to the subject of this evening, and I start by further explaining here, that those remarks had reference to the fact that in the phonograph it was impossible to make a loud reproduction which at the same time would be natural in tone. So long as you confine yourself to the small telephone voice the sound is natural and very satisfactory, but so soon as you attempt to indent at greater depth the waves are distorted and the sound becomes unnatural. In the gramophone, as you will further on see, and I suppose you are perfectly familiar with the principle, there is no indenting and no engraving, but there is a constant resistance, that of the light pressure of an elastic blade on a flat surface, or on a cylinder, if you please, but whatever resistance there may be, it is constant. And that is the principal difference, speaking scientifically, between the phonograph and the gramophone, that in one you have a variable resistance, in the other a constant resistance.

In May, 1888, before a meeting of the Franklin Institute, in Philadelphia, I showed publicly for the first time, how sound-records could be etched in metal, and how the original sound could again be made audible from such etchings. What I there demonstrated was of necessity crude in its effects, because embodied in the invention were a number of entirely new processes, new principles of construction and an art which dealt with motions infinitesimally small, the effects of which cannot altogether be either seen or measured; all of which was brought to bear on the single problem of fixing forever and with as much resemblance to nature as possible, both in loudness and quality, the sounds of instruments, of noises of all kinds, and of that delicate and subtle form of energy, called the human voice.

At the same meeting, I read a lengthy paper dealing with the history of the twin arts, that of transmitting sound electrically, and that of recording and reproducing the same mechanically. That the development of both arts occurred as I then showed—in parallel steps—is not the only excuse for bringing talking-machines before electrical societies.

In the gramophone, at least, there occur materials and processes, which, partly or wholly electrical, comprise terms familiar to every electrical engineer. Zinc, acid, bichromate of potash, diaphragms, dampers, electrotyping, all these play their part in the technique of the gramophone, not to speak of the possibility of applying electric motors to drive the machines, and of using the electric current for rapid etching.

The science of electricity almost began with immersing zinc in acid, but crude force alone is thereby set free, while in the gramophone, the action of the acid on the metal is so curbed and regulated that under it the zinc becomes a picture of sound-waves which, though slumbering in a bed of hard metal, is ready at any time, even centuries hence, to burst forth into the soft cadenzas of word and song, the ripple of laughter, the strains of martial music, as well as the melancholy and imploring drag of the organ-grinder's tuneful melody.

The hydrogen which would otherwise be set free, is neutralized by the well-known depolarizer, chromic acid, and the carrier of the recorded sound-waves is so perfectly and yet so delicately insulated from the action of the acid, that a spiral of sound undulations 600 feet in length, could, without difficulty, be traced and etched on an 8-inch disc, and would represent when reproduced a continuous conversation lasting 7 minutes; all this automatically, and with far greater facility than is possible in making a photograph picture.

In the art of etching, that which insulates the metal from the action of the acid is called an etching-ground, and in the gramophone, this etching-ground is a very delicate fatty film, deposited from the fluid state upon the metal surface. This fluid is made as follows: Into a bottle containing one quart of gasoline, benzine, or petroleum ether, are put 2 oz. of scraped, dark yellow beeswax, and allowed to digest, with occasional stirring, for several hours. We shall then find a clear yellow fluid on the top, and a white cheese-like precipitate at the bottom. The clear fluid is decanted or syphoned off into another bottle, and diluted with the same quantity of gasoline.

When this fluid is poured on an absolutely clean and slightly warmed metal surface, there remains after the gasoline has evaporated, a delicate fatty film, very porous, and so thin that it shines in iridescent colors. It is somewhat tenacious to the touch, but loses its resistance in a remarkable degree when alcohol is poured over it. As soon, however, as the alcohol is washed off with water, the film assumes again its tenacious quality with but very small loss in weight, due to its dissolving slightly in alcohol.

As this etching-ground forms one of the keys to the whole gramophonic art, I will illustrate its qualities by the following experiment:

I have here a strip of zinc, over which the fatty film above described has been deposited from the solution of waxy fat. I have here also a piece of blotting paper, and with its edge touching the film, I now draw several cross-lines on the zinc. Next, I pour alcohol over it and draw a single line over the length of the strip, taking care to touch the surface as lightly as possible. I now wash off the alcohol and plunge the strip into this glass containing a solution of chromic acid, and you will presently see the long line appearing as a dark streak on the zinc, while the cross-lines appear less marked and more reluctantly, showing that the film offered less resistance under the alcohol than without it.

When after about 10 minutes, we take the strip out, we will find under a magnifying glass, that the track of each cotton fibre

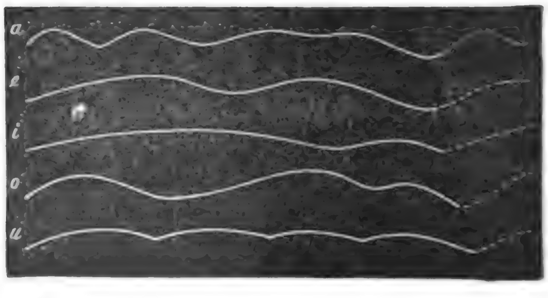


Fig. 2.—Gramophonic Vowel Records.

of which the blotting-paper consists, is sharply etched into the zinc; the rest of the metal has remained entirely untouched. Such is the nature of the etching-ground used in the gramophone for etching sound records.

I will now illustrate how such records are produced, but I would like first to recapitulate briefly what I dealt with at length before the Franklin Institute, relating to the history of the art of making sound-records of the human voice. That dates back to the year 1857, when Leon Scott patented his phonautograph, which is described in every book on physical science. It consisted, as you see on that picture yonder, of a cylinder mounted on a screw, and turned by hand, a barrel-shaped mouthpiece, a diaphragm provided with a damping device, a flexible stylus attached to the centre of the diaphragm, and means for adjusting the position of stylus and record sheet to each other. The cylinder is

1. Paper read before the American Institute of Electrical Engineers, Dec. 16, 1890. Engravings are from the *Scientific American*.

covered with paper smoked with an oily flame, after which the stylus is so adjusted that it presses lightly on the smoked surface. When the cylinder is now revolved, the stylus traces a spiral line on the paper, and when at the same time sound enters the barrel, the diaphragm will vibrate, and the spiral line will assume an undulatory form, according to the nature and pitch of the sound emitted.

Such tracings of sound are called "phonautograms," but since tion of the phonograph, but the technical difficulties which appear in the attempt to bring about the desired result, must have seemed too great to Cros; or he must have gotten discouraged when, later on, seeing the apparently simpler method of the phonograph. At any rate, it appears that he never accomplished what he had conceived with such acute logic, and his paper on the subject (which can be found in the *Comptes Rendus*) was barely noticed, and quickly forgotten.

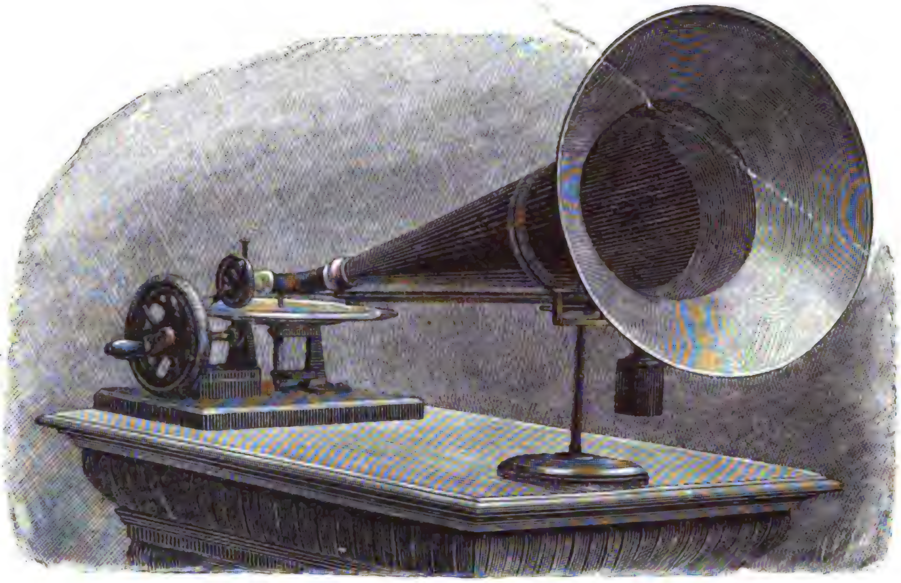


Fig. 3.—Berliner's Improved Gramophne: Reproducing a Record.

I have found that those published as having been made by the phonautograph are not true curves of the sounds they were supposed to represent, I have here some which are more correct, and drawn from gramophone records, representing some of the more prominent vowels, Fig. 2. The waves are complex in character, and between 75 to 150 of these compound waves follow each other per second in the pitch of the ordinary human voice; all of which is well known, and described in the chapters on sound of physical science,

In the spring of 1877, and following in the wake of the invention of the speaking telephone, it occurred to Charles Cros, of Paris, that if such sound-tracings could be engraved, for instance, by the photo-engraving method, and the stylus be then permitted to travel again in the groove or track of these engraved record lines, by revolving the cylinder past the stylus, the original sound would be reproduced. This was about 6 months before the inven-

It was not until after the granting of the patent for the gramophone, that I happened to see a reference to it, and, searching the *Comptes Rendus*, found the article mentioned, which I then translated and embodied verbatim in my paper before the Franklin Institute. While, however, Cros had a correct conception of the general principle of a talking machine, it would have required considerable modification of the rules taught by physical science which were then at his command to obtain practical results; but I will illustrate what he meant, with this model built on the principle of the gramophone.

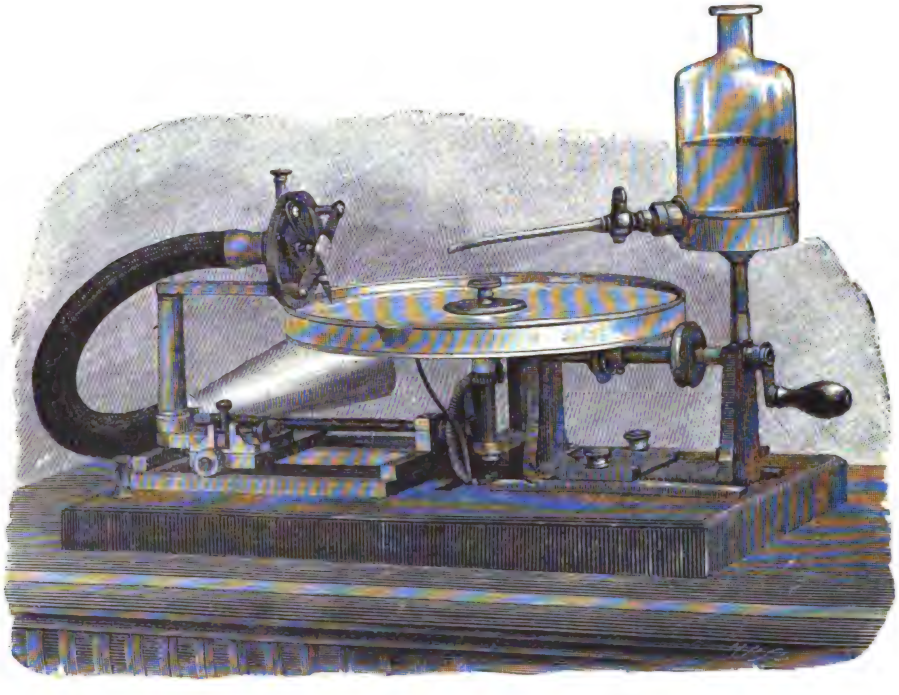


Fig. 4.—Berliner Gramophone—Apparatus For Making Records.

Here is a drum-head of oil-cloth, and across it and pivoted at the top, is an arm or stylus, which is connected to the centre of the drum, and therefore, moves with the latter. The free end of the arm extends beyond the periphery of the drum and carries a brush dipped in ink.

If I now pass a strip of paper underneath the brush and at the

same time move the drum regularly to and fro, an undulatory line of regular character will be drawn on the paper. If I repeat the experiment, but more irregularly, or jerky, the motions of the drum appear marked down as a jerky irregular line.

I now replace the brush by a hard stick and permit it to travel in an undulatory groove engraved in a strip of wood, which strip I draw underneath the stick, and you will see by the reflection of light on the oil-cloth drum-head, that it is moved to and fro by the engraved wave-line, and if these motions should occur rapidly enough, a sound would be emitted by the drum.

This illustrates the general principle of the gramophone. It is, however, in the method of engraving the sound-records that the gramophone departs materially from previous methods, and this I will now show you—Figs. 3 and 4. Here is a disc of ordinary zinc, such as you can buy in every tinshop; it has been polished, carefully cleaned, and has then been coated with our fatty film. I now place the zinc on the turn-table of the gramophone recorder. The turn-table is revolved by a friction-wheel underneath, and connects through gearing with a screw, which propels a carriage across the turn-table, at a slow rate of progression. On this carriage is mounted the recorder proper, namely, a mica diaphragm, across which lies a spring, fastened above and carrying at the lower free end a slender metallic blade, bent downwards slightly, and tipped with iridium, like a gold pen. This blade I now bring down upon the fatty film until it is straightened.

Mounted near the turn-table is a bottle containing alcohol, from which a spout extends to the centre of the turn-table, dropping the fluid upon the fatty film on which I first pour some of it, so as to soak it.

If I now revolve the turn-table, the blade or pen marks a plain line into the fatty film, and as the iridium tip is kept free from the dust-fibres which are continually floating about in the air, and upon the film also, by the presence of the alcohol, the line in proper light appears as a fine silvery streak in the dull fatty surface, showing that the metal is being laid bare by the iridium tip.

If, now, sound enters the tube leading to the diaphram, the atter will vibrate and the line will assume the undulatory form of sound-waves, as before explained.

The gearing of the machine is at present set so that 72 lines are drawn to the inch; but for the ordinary conversational tone, the lines might be twice as close together, without the waves touching. The turn-table revolves at the rate of about 60 times a minute for this size of disc, and if they are smaller, the velocity must be increased, so as not to crowd the waves too close upon one another.

The talking being done, I lift the disc from the machine and dip it in water, which washes off the alcohol, and there is now visible a band of silvery lines in the fatty film. I may now write the date in the central portion of the disc, and press the patent-stamp on it, or add any other remark or signature, all of which will be subsequently etched in, and I may now plunge the disc into the bath of chromic acid. Immediately, the acid attacks the zinc in the lines, and a dark cloud forms over the record, due to the formation of a subchromate of zinc.

While the disc is being etched, let me now turn to the reproducing machine. The principal part is again a turn-table moved by a friction wheel underneath. Above it is an arm pivoted with one end upon a standard having a double or universal motion, and the other end carries the reproducer proper, namely, a diaphragm or mica vulcanized fibre, rubber, or ivory, across which is fixed at its upper end, a stiff spring connected by a post to the centre of the diaphragm, its free end extending beyond the periphery, and carrying a small steel needle which may easily be taken out and replaced when necessary. This pivoted arm is the invention of Mr. Werner Suess, of Washington.

One of the mechanical curiosities of the gramophone is the fact that the etched record itself is the screw which propels the the diaphragm from periphery to centre, for the stylus resting in the groove by gravity or slight pressure, not only is vibrated, but following it and being able to move freely, is led along to the centre and to the end of the etched record automatically. This places the gramophone reproducer in the realm of extreme simplicity, and beyond the necessity of repair under ordinary every-day conditions.

Before proceeding further, I will now let the gramophone show you some of the results of which it is capable at the present time. I should like to remark, that in the present form of the resonator, the sharpness of the effects is somewhat toned down. That this is due to the resonator will become more apparent to you when, later in the evening, you will listen to some of the discs through the rubber ear-tubes. It has been proposed to use a resonator in the form of a large parabolic reflector, so as to enlarge the effects without modifying the timbre. But the effects, although loud, show the natural qualities of the various sounds, and are, in spite of their loudness, neither rasping nor ventriloquistic in quality.

The possibilities of extending the gramophonic principle, are perhaps more noteworthy than its present development. The discs can be easily duplicated, and at the first exhibition in Philadelphia, I showed an electrotype copy of a 12-inch disc which sounded precisely like the original. Since then, I have also succeeded in making talking copies by pressing a matrix into molten glass, but the matrix being [illegible] of copper, the glass used to stick to the form, and warped the glass copy. I am assured, however, that whenever I shall furnish a steel matrix, the perfect copying in glass will be entirely feasible. That such steel matrices can be made is not doubted by those familiar with the art of transferring lines, and then etching the same.

We may then have dinnersets, the dessert-plates of which have gramophone records pressed in them, and which will furnish the after-dinner entertainment when the repast is over. Gramophone plaques with the voices of eminent people will adorn our parlors and libraries.

Very successful copies have been made in celluloid from electrotype matrices, and such celluloid copies are particularly free from all frictional noise, provided the celluloid is pressed hard, and of well-seasoned material. Gramophone records have been printed, and such prints have been photo-engraved, and the copy thus obtained sounded precisely like the original.

Successful copies have been made by letting one disc sing or talk to another one by coupling the recorder to the reproducer by a tube, and turning both simultaneously. In fact, this whole matter of duplicating discs is a department in itself, and would require a separate evening to do it full justice.

The work of gradually bringing the gramophone up to the present state has been exceedingly tedious. Working out telephones or transmitters is child's-play in the face of the traps and Jack-o'-lanterns which beset the experiments with talking machines. The size, form and material of the mouth-piece, the density, length and diameter of the speaking-tube, the size, thickness and material of the diaphragms, the tension, temper and thickness of the springs, shape of the needle points, temperature of the room in which the discs are coated, the quality of the bees-wax, the strength of the acid, and the method of manipulating the sound of voices and of various instruments—all these gave rise to errors and pitfalls, which only continuous repetitions of whole series of tests could locate, avoid, or obliterate.

I have to dwell on these facts, in order to ask your indulgence in not having been able for this evening to cover the important field of copying records—but I have also been disappointed in not receiving a number of celluloid discs, such as are now being made in Germany.

The important subject of good articulation has ever been kept in the foreground, and this is now in so satisfactory a shape that I am carrying on a vocal correspondence with my friends in Europe, by means of small gramophone discs, which can be mailed in a good-sized letter envelope.

Foremost among the feats which the gramophone can perform is the absolute certainty with which it enables people to recognize the speaker's voice, and I could cite a number of instances where persons have been made happy by hearing and recognizing the voices of loved ones whom they had not seen in years, and the owners of which were thousands of miles away.

This whole art is now manipulated with great certainty, and can be learned much easier than the art of photography. Yet, favorably as I believe the gramophone compares with other talking machines, it has barely entered upon the possibilities which lie dormant within its principles, only awaiting the touch of investigation to yield new and important scientific data.

Its advantages at the present time can be summed up as follows:

1. The records are durable, and require a minimum of space for storing.
2. Recognition is perfect.
3. The mechanism of the reproducing machine is a model of simplicity.
4. The records can be printed, and from such prints copies can be made which will sound like the original.
5. The quality of the sounds does not become impaired with increasing loudness.
6. The making of copies is possible by several well-known methods in existing arts.

Lastly, I ought to again refer to the possibilities of enlarging the record lines by the photo-engraving process, and thereby rendering the sounds with increased loudness.

Whatever the art of gramophony represents at the present time, does not consist of accidental results, but the principles and the errors to be avoided are well-known and established, and not a month passes but that new light is thrown on hitherto obscure sections of manipulation, and after three years of work, in which numberless sources of error have been eliminated, the art of etching records has lost none of its attraction, rather fascinating the mind by presenting the possibility of unlimited applications in the service and for the pleasure of mankind.

OPEN HOUSE AT THE ELECTRIC CLUB.

Secretary Price notifies us that the Electric Club will keep open house on New Year's Day from noon on. A buffet lunch will be served, and the Club's silver punch bowl will be replenished as often as is necessary. It is becoming quite the thing to drop in at the Club on New Years for a kindly greeting and a fraternal "send off."

ELECTRICAL UNITS OF THE PRESENT AND FUTURE.[1]

BY PROF. FRANCIS B. CROCKER.

To measure quantities of any kind some unit is needed. In the crude, ancient days the roughest kind of units were sufficient. The length of the king's foot, of a barleycorn, or the side of some temple, or a stone in a pyramid, or something of that sort, were quite good enough for a unit. In fact, nothing better was needed. But as soon as the exact sciences devoloped astronomy, mechanics and other branches of science, and when commerce became more important and definite, the necessity for some more exact unit arose. The rough units I refer to are not only rough, but they are arbitrary. They might just as well select some other king's foot or some other stone in the pyramid, instead of the particular one selected. The more exact requirements of advanced work at first only required definite standards. Therefore the standard yard and the standard quart were adopted, but they were arbitrary. Some person decided what they should be and they were carefully made and deposited in the national archives, and exact copies of those were made and sent around to various points, and they became in some cases the legal standards.

Standards can be adopted by custom or by law. Some of the standards in common use are legalized and some are not. One or more of our most common standards have not been legalized.

So far they had merely arbitrary units. The quart bore no relation to the yard; the yard bore no relation to the second, and neither of the three bore any simple relation to any other unit. That is to say, the fraction representing the relations between the two would have several decimal places. But nevertheless each was definite in itself. The standard yard was a definite length of metal and carefully preserved. Therefore, it was as exact as any unit can possibly be, but it had the disadvantage of having no simple relation to any other unit, and when we pass from yards to quarts and from quarts to pounds, etc., we have no convenient way of translating the quantities. We are obliged to use very awkward figures. What is needed is an *absolute system* in which the units bear exact and easily remembered relations to each other. That is the essence of what is called the absolute system. But it happens that an absolute unit is a very hard thing to obtain. It is impossible to look about and find a standard length that is derived from any source that is unquestionable. It is a matter of judgment and choice, and nothing seems to be very satisfactory for the purpose.

The three facts in nature which are supposed to be absolute, and that philosophers look upon as the three fundamental conditions of existence and thought, are time, space and matter. These three facts are supposed to be fundamental, and everything else is a combination of them.

Therefore, time, space and matter were selected as the fundamental quantities, and it was necessary to find a unit for each.

Taking space or length, which amounts to the same thing, as the first, they began by measuring the circumference of the earth, or, rather, a quarter of it—the earth's quadrant—which is the distance from the pole to the equator. Of course, the actual distance from the pole to the equator was not measured; they measured one degree of it, and calculated from that.

Unfortunately, an error was made that would not be of consequence in anything else, but in the case of a foundation of a system of units it amounts to something—about one one-hundredth of one per cent. Nevertheless, from that measurement the unit was determined. But the question arose, what fraction of the earth's quadrant to take as the unit. Of course, it must be a round number. A ten-millionth happens to be about equal to a yard. A one hundred-millionth would be too small—about four inches. One is a little too small and the other is too large a convenient unit of length. The foot, which is a very convenient unit of length, is between the two, but unfortunately the earth didn't lend itself to this system of units. They chose the larger one, and made the metre the standard of length. The metre is simply one ten-millionth of the earth's quadrant, as measured by the French authorities.

Having the metre, the question was to get a unit of weight. The unit of weight may easily be gotten by cubing—that is, making a volume from the unit of length and filling it with water. But a cubic metre of water would, of course, be too large for a unit of weight, as it weighs about a ton, so a fraction of it was taken. Here again a choice was necessary. A cubic centimetre of water was selected and called the gramme. I think that was a great mistake, because a centimetre is a very small thing and has tended to bring the whole system of absolute units into disrepute. It seems so small that it is not worth considering. I think if they had taken the decimetre, the tenth of the metre, as the unit of length and the cubic decimetre of water as the unit of weight we should have very much better and more harmonious units. A metre is too large and a gramme too small. The unit of time has already been selected. The second is simply the ordinary second that is used in calculating time all over the world and is also a very small unit. Thus we obtain the three primordial standards of length, mass and time, and since, for scientific purposes, the centimetre is taken instead of the metre, we have the centimetre, gramme and second as the three fundamental units upon which is based the C. G. S. system of units. Theoretically, and probably practically, all units of every kind, present and future, can be derived from these three simple fundamental units, which we can all understand and know just how they were obtained and what their values are. The mechanical units are very easily derived from the fundamental units.

There are two fundamental laws of electricity. One is Coulomb's law, which applies to static electricity, and states that a certain charge of electricity attracts or repels another certain charge with a force directly proportional to the product of the quantities and inversely proportional to the square of the distance. The fundamental law of the electric current is that of Ampere, which states that a current affects a magnet in proportion to the strength of the magnet and of the current, the length of the wire, and inversely proportionally to the square of its distance from the magnet. As we can measure the length of the wire and the square of the distance, hence we can get the strength of the current. But this involves having magnetic units. Here are two bar magnets supposed to be exactly alike. If I bring the North poles together they repel each other; and if the magnets were delicately suspended on silk fibres, and brought within a unit's distance and the repulsion between them accurately measured by the torsion of the fibre or by balancing them against some other known force—a delicate spring—then I would find how many units of pole strength the magnet had. To get a unit magnetic field from this we say that a unit pole placed at a unit's distance produces a unit's strength of field. The field is the important thing in dynamo machines and many other practical cases.

To get a line of force, which, by the way, is the unit that is most used in practice, we produce unit field and take a unit's area of it, which is called line of force. It is to a certain extent arbitrary, but it is definite, nevertheless, and that is the line of force that we use so much. We read of it in text books and even in the daily papers.

To return to measuring the current. We take a unit pole and when it has a unit of force exerted on it by unit strength of a current at a unit's distance and a unit length, then it is a unit current. Thus we pass from the quadrant of the earth to the unit of the current by several simple steps, each one of which is easy to understand and each one of which is perfectly logical and follows directly from the previous one.

From current, which is, in my opinion, the fundamental unit of useful electricity, we obtain quantity of electricity. Quantity of electricity is simply the amount of electricity that flows in a unit current for a unit time. Now, electromotive force is about the most troublesome one of these units. It means the tendency for electricity to produce a current and do work. Therefore, electromotive force multiplied by quantity of electricity would give you the work. If I have a certain electromotive force and one unit of quantity I will have a certain work that will be measured by the electromotive force.

Ohm's law gives the resistance as equal to the electromotive force divided by the current, these last two being known. From here on the derivation of the rest of the units is a mere clerical matter. For example, taking capacity as the next unit, we find it equal to quantity divided by potential, that is, the unit of capacity will hold a unit quantity at a unit potential. Work, as I have already explained above, is equal to potential times quantity. Power is rate of work. Therefore, potential multiplied by current, quantity per second, is power.

We come now to self-induction.

Self-induction is somewhat unfamiliar, nevertheless, it is becoming important. Self-induction in telephone work, in aerial, under-ground and submarine lines, dynamo armatures, dynamo field magnets, transformers and other alternating current apparatus, are all practical cases of self-induction. We should consider self-induction almost as much as resistance. We have not done so heretofore, but that is no reason why we should not in the future.

It happens that there are several ways of defining self-induction, but the best way, I think, is to consider it as a counter electromotive force. That is to say, when I send a telephone current through an electro-magnet the latter reacts against the current. When the current tries to go through, the magnet tries to oppose it. Therefore, the best way to define the unit self-induction is to say that it gives a unit counter electromotive force when there is a unit change of current in a unit time. The ordinary way, however, for deriving this unit is to multiply resistance by time. That seems to be an odd way to get it, but what it means is this: That self-induction is the apparent increase in resistance that we get when we try to pass a current through a circuit. But after the current has got flowing, so to speak, then self-induction ceases to exist. It only occurs when a change is taking place.

1. Abstract of an Address delivered before the Electric Club, New York Dec. 18, 1890.

The absolute units have no names, they are simply designated as absolute units of electromotive force, resistance or quantity, as the case may be. This means that they are derived directly from the centimetre, gramme, and second, and "dimensions" of units are mathematical ways of expressing how these fundamental quantities enter each unit. Some of them involve all three of these quantities, some involve two, and some only one. Take, for instance, area. Area is L square; that is, the square of the length; for example, a foot square is an area. Volume is L cube. Velocity is L divided by T. That is, it is L multiplied by T to the minus one power. This enables us to put them all on the same line for convenience.

We come now to the practical units. Every one of these absolute units, derived, as I said, are either so small or so big that they are not useful.

It was necessary to take a certain number of a fraction of an absolute unit. In the case of resistance they took such a number of absolute units in round numbers as would most nearly approach the Siemens unit which had been used before and it happened to be 10^9 absolute units, which means that a billion of these little bits of absolute units will make one ohm the practical unit of resistance, naming it after the discoverer of Ohm's law and establishing the precedent of naming all the electric units after distinguished electrical scientific men, which rule has been followed without exception to the last unit. They call 10^8, that is, 100,000,000 absolute units of electromotive force, a volt, That approximated most closely in round number to the Daniell cell which had previously been used as the unit of electromotive force. They selected the nearest units to the two units already in existence, and having fixed those, theoretical value of the ampere followed. Having arrived at the current absolutely, we can also determine how much metal a current will deposit. But we cannot calculate it absolutely, however; we must determine it. I have here the exact weight of silver that one ampere will deposit from a chloride solution in one hour. It was carefully weighed by the Assay Department of the School of Mines, and it is right to the tenth of a milligramme and weighs 4.0248 grammes. The ampere is a unit that is easily determined. The volt and the ohm required laborious work of years, and the original ohm, as determined by the British Association committee, was about 1¼ per cent. wrong, which is a pretty bad mistake for a scientific measurement.

In making actual standards of these units, the volt is the most elusive one of all. The tangent galvanometer and the silver deposition give up the ampere pretty well, and for the ohm we have a definite coil. But the volt is dependent on standard cells containing chemicals that are very apt to change. They are compounds and they are apt to decompose or change in their composition.

It happens that the unit of capacity, the farad, is a very large unit and we have to take a millionth of it to get a working unit. The microfarad is the standard and it is a pretty good sized standard. It is equal to the capacity of two or three miles of the Atlantic cable. It would contain the same quantity of electricity as two or three miles of Atlantic cable, and it would take a thousand Atlantic cables to equal one farad in capacity. Therefore, you see that what is called the "practical unit" of capacity is very impracticable. The reason the farad is so large is that we have obliged ourselves to define units in terms of one volt, one coulomb, etc. Now, with static electricity, one volt is very small. Our ordinary static charges are 100,000 volts or more; for instance it takes about 100,000 volts to spark one inch.

I would like to point out the fact that we have "absolute units" and "practical units," so called. I put both of these in quotation marks. Absolute units, as I have said, are not absolute, they are based on an arbitrary dimension of the earth incorrectly measured. Now, practical units in the same way, are not practical, because we have one, the farad, that is 1,000 times greater than the greatest practical capacity in existence. Therefore, I maintain that we must have a third system of units and that is the "working" units. You could call them "commercial," but the objection to that is that they are equally used in the laboratory as in commercial work. We use a microfarad in the laboratory the same as in the office of a telephone or cable company. Therefore, they are not, strictly speaking, commercial, but they are *working* in both cases. Sometimes the working units agree with the practical and sometimes they do not. The ampere, coulomb and volt are the same, although in telegraphy we use the milliampere. Then we come to the ohm. That is, the ohm is right for most practical work, but for insulation tests we have to use a megohm. Nobody thinks of giving insulation tests except in megohms. Therefore, for that class of work, the working unit is the megohm and not what is called the practical unit.

When we come to the microfarad, there is no question. The practical unit ceases entirely to be practical, and we have to adopt the working unit which is almost infinitely different.

The watt is a convenient unit for a great many purposes, but when we use it for large work we use the kilowatt, which, by the way, is a good way of rating dynamos, because it is fairly near a horse-power.

Then we come down to the last of all—the henry, the new member of the family, and it is a question whether the working unit will be a henry or a millihenry. I did think of reducing the value of the henry to $\frac{1}{1000}$ of its value as given in the table; but it would have been a mistake, for the reason that, instead of having its value one second multiplied by one ohm, we would have its value a second multiplied by a thousandth of an ohm or a hundredth of an ohm. That would be destroying the simplicity and the harmony of this system—a feature which it certainly does possess. Every one of these units is derived from every other one in the simple ratio of one to one, and in no case is there any complex relationship of a thousandth or ten-thousandth or anything of that sort. You see that the coulomb is an ampere multiplied by a second, a volt is one ampere multiplied by an ohm, a farad is a coulomb divided by a volt. A joule is a volt multiplied by a coulomb, and a henry is a second multiplied by an ohm; and to make any one of them variant, would I think, be a mistake, particularly as it would have been the only exception to the harmony of the system.

Fortunately, the henry approximates a practical value. For example, a large Edison dynamo, shunt wound, will run up to one or more hundred henrys. A telephone magnet will be between $\frac{1}{100}$ and $\frac{1}{10}$ of a henry. We could not expect that to be a very large value. An ordinary relay is several henrys in value. A large induction coil is often 1,000 or more henrys in value. Therefore, there is nothing preposterously small or large about the henry. It is about right. I have given in the last column of the table the actual or experimental value. That is, 4.025 grammes of silver per hour is the ampere. The volt is .926 of a Daniell cell. The legal ohm is 106 centimetres of mercury one square millimetre in cross section, etc. The unit of self-induction is equivalent to the length of the earth's quadrant. Thus we see that often starting with the earth's quadrant in this system of units, to obtain the fundamental units of length, and passing through all the mechanical units and the electric units, we finally get back to the earth's quadrant again. It is certainly quite remarkable and striking. It is a fact, nevertheless, that the unit self-induction is properly represented by a length equal to the earth's quadrant. In fact, it has been called the quadrant and was so called by the Paris Conference, which, I think, was a great unfairness to American electrical men, both living and dead, because certainly America's contributions to electrical science and industry have been fully equal to those of any other county, and if England has the farad, joule and watt, named in honor of her distinguished electrical scientists, if France has the coulomb and ampere, if Germany has got the ohm, and if Italy has got the volt, I think it is certainly not unreasonable for us on this side of the Atlantic to ask for one unit, to be named after the discoverer of self-induction, Joseph Henry.

In regard to future units, which the requirements of advanced work will soon necessitate, we need a unit of the strength of a magnetic field. We can express it as so many lines of force to the square centimetre, etc., but that is a very clumsy way. If we simply called it one Franklin, it would be very preferable to a long sentence. We all have in mind the naming of some electric unit after Franklin, but, unfortunately, Franklin is not identified with magnetic work. He is identified with electrostatic work, but all the electrostatic units have been named. But, perhaps, his name may be adopted.

This treatment of units is necessarily superficial and all I have attempted to do is to show you the general derivation of them, starting with the very first conception and coming to the present time and a little beyond.

DETERIORATION OF ELECTRIC RAILWAY RETURN CIRCUITS.

President D. F. Henry, of the Federal Street and Pleasant Valley Railway Co., Pittsburgh, has been complaining of the rapid deterioration of the return conductors of that road. He says that they may have to adopt an overhead return conductor, owing to the rapid deterioration of the underground connecting wires in the peculiar soil of Pittsburgh. A striking fact is noted in connection with the return conductor leading from the track rail to the negative poles of the generators. This is a large insulated wire, and that portion which is laid under the floor of the power house is encased in a wooden box or trough, while under the sidewalk about six feet from the rail it is embedded in the soil. On cutting through the insulation recently that portion of the conductor laid in the soil was found to be almost destroyed, while the section in the wooden casing was, apparently, as good as new.

THE PRESIDENT'S MESSAGE.—The Western Union Telegraph Company handled the President's message and furnished it gratis to the press of the country as a compliment to the press and the people. It contains about 14,000 words.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.
Anonymous communications cannot be noticed.
The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.
In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.
Sketches and drawings for illustrations should be on separate pieces of paper.
All communications should be addressed EDITOR OF THE ELECTRICAL ENGINEER, *150 Broadway, New York city.*

METHODS OF TESTING TRANSFORMERS.

[152.]—Dr. Louis Duncan in his letter (147) to THE ELECTRICAL ENGINEER, December 3, 1890, p. 627, refers to the disposition which he thinks certain recent investigators have shown "to claim as original in 1890, a method which was not new in principle in 1887,........."

Whether there is anything in the papers of Mr. Ryan, of Messrs. Humphrey and Powell, or of Messrs. Tobey and Walbridge to warrant Dr. Duncan's remarks, readers must judge for themselves; but I desire to say that it was not the purpose of any of the students of alternating current phenomena at Cornell, to put forth *claims* of any kind. Their sole purpose was to describe certain sets of measurements. Mr. Ryan's first paper, although entitled "Transformers" was in fact a study of a *single* commercial transformer, under conditions commonly met with in practice. The work of Humphrey and Powell was supplementary to that which Messrs. Ryan and Merritt had done. The paper of Tobey and Walbridge did not deal with methods of testing alternating current dynamos, but with certain interesting peculiarities in a new type of machine.

The absence of any attempt at historical review, even in these papers of narrow and definite scope, is, in my opinion, to be regretted; but the authors have followed a pretty well established precedent, so far as the publication of papers of the class in question is concerned, as any one may easily convince himself of by glancing through the *Transactions* of the American Institute of Electrical Engineers, and to ascribe the omission to an unworthy motive, is unjust.

The expression from Humphrey and Powell which Dr. Duncan quotes, and to which he takes exception, is incomplete. That portion of the sentence which he has omitted to quote in his letter, indicates clearly enough that it was not to the method which Dr. Duncan has characterized as "not new in principle in 1887," that Humphrey and Powell refer, but to a modification of it. The modification was one which made it possible to get "true instantaneous values of E. M. F. and current in forty-five minutes." The importance of this modification is a matter of opinion. Dr. Duncan deems it insignificant. Had he had the opportunity of putting the Ryan electrometer to the test and of comparing its performance in this kind of work, with that of the Thomson quadrant electrometer, he might perhaps have found the opinion of Humphrey and Powell that an important step in the matter of transformer tests had been taken within the year, not altogether unwarranted. The relation of the methods used by Mr. Ryan and his co-workers, to those of an earlier day, of which they were, of course, as in all such cases, a development, is a matter of history. What fragment each investigation adds to the sum of human knowledge the future will determine. In the mean time should there be cause for anything but sincere satisfaction in the fact that the investigations of Duncan, Hutchinson and Wilkes in 1887, and of Searing and Hoffman of the Stevens Institute, in 1889, have met with complete corroboration through the work of the still later observers? EDW. L. NICHOLS.

CORNELL UNIVERSITY, Ithaca, Dec. 18, 1890.

TRAIN ELECTRIC LIGHTING.

A new electric lighting system for railway cars is to be placed on the market some time during the year 1891 by the Consolidated Car Heating Co. Each car will have an independent source of light which will be available even when the car is at rest for five hours, or perhaps longer. The tax upon the motive power will be slight and indirect, no steam being used. The designers are now endeavoring to so simplify and cheapen the apparatus that it shall be, both in first cost and in running expense, more economical than any lights now used in first-class cars. The system will include storage batteries and a dynamo on each car, driven from the car axle.

ABANDONING CABLES FOR ELECTRICITY AT GRAND RAPIDS, MICH.

Director Hagar, of the Grand Rapids Consolidated Street Railway Co., which has a million dollar cable system, says that they will put in probably 45 miles of electric road next year. They have 14 miles of cable road which will be abandoned, the cable cars being replaced by electric cars, and overhead wires being strung above the present cable tracks. It is said to be likely that the Short system will be used.

EUROPEAN CORRESPONDENCE.

LONDON.

Electrical Underground Railway.—Provisional Orders.—Paper on Insulation.—Paris Telephones.—Obituary.—Royal Society.—Hamburg.—Prof. Ewing.—Overhead Wires.

THE Austrian Minister of Commerce has sent two engineers to study the new underground electric railway in London.

The time limited by the Board of Trade for receiving applications for provisional orders to be considered for 1891, expired on the twenty-eighth of November. I am informed by a creditable source, that no fewer than seventy-six separate orders will be applied for, of which seventeen seek power to light various portions of London and the suburbs. I think the greater number of applicants will be found to be companies, but as few will be opposed, the next twelve months should see a rapid development in town lighting.

An interesting paper was read before a recent meeting of the Berlin Electro-Technical Society by M. Grawinkel. The subject taken was the condition of underground mains belonging to the Administration of Posts and Telegraphs of the German Empire. In contrasting the results of tests taken during 1889 with those of former years the author concludes that the insulation of newer cables is much inferior to that of older cables. This is due to the inferior quality of gutta percha now employed, consequent on the enormous demand for the material.

After this week Paris telephone customers will be treated very liberally by the Telephone Department. For a sum equivalent to 10 cents a person may transmit a message to the central bureau of 100 words and a special messenger will convey it to the desired destination.

The plan for an electric street railway in Karlsbad, which is to go from the railway station into the town, has been passed and next summer, in addition to electric lighting, a tramway operated electrically will be working.

M. Bede, a prominent Belgian electrician and engineer, died this week. He was one of the leading members of the Brussels Polytechnic School and successfully carried out many important electrical installations in Russia and Italy.

The annual meeting of the Royal Society was held on Monday. In the course of his remarks the retiring president (Sir G. Stokes) said that the Society had received from the Joule Memorial Committee £1,400. Medals were awarded, one of the recipients being Dr. Hopkinson. At the dinner in the evening the new president Sir Wm. Thomson, occupied the chair, and proposed the health of the medalists and the visitors, among whom was Prof. Hertz. In the speaker's opinion Dr. Hopkinson's researches in magnetism and electricity affected the whole range of physical science, while Dr. Hertz's work in electro-magnetic radiation was of an epoch-making character. Dr. Hopkinson in responding spoke of the assistance foreign governments gave to their scientific men in making researches He said deliberately that if he had been obliged to obtain the sanction of the English Government Department to make experiments or make them in a licensed place, very little work would have been done, and he should not have been in the proud position of one of the medalists that evening.

The Hamburg authorities have granted £15,000 for an electric light installation and for structural improvements in the Hamburg Stadt Theatres.

It is proposed by a German firm to conduct experiments on the Finow Canal with electric launches.

One of the greatest authorities on English tramways from a financial point of review in a monthly report says there is a good time coming for holders of tramway shares and that is when electricity operates their lines. He considers there will be a complete revolution in the finances.

Prof. Ewing has succeeded Prof. Stuart in the chair of engineering at Cambridge.

We are likely to have some hard fighting over the subject of overhead lines. Last week memorials were submitted to the Board of Trade calling attention to clauses which were unnecessary and likely to retard the spread of electric lighting. The rules on which the Board works were framed by the Council of the Institution of Electrical Engineers, and it is argued with apparently some reason, that the framers were not practical men. The rules stickle for heavy insulation and other conditions which will have the effect of rendering electric lighting too costly, if persisted in. At the present time, the lighting carried out at Farnham and Chelmsford is against the rules. It will be interesting to see how the rules are to be enforced.

Many of the principal streets are up and mains are being laid, much to the annoyance of shop-keepers and pedestrians.

H. S.

LONDON, Dec. 3, 1890.

CORRESPONDENCE.

BOSTON.

Visiting Baltimorians.—The Snow Storm.

The mayor and city council of Baltimore visited Boston last week, as the guests of the North Avenue Street Railway Company of that city, for the purpose of inspecting the electric car system of the West End Street Railway Company. The party made a trip in the electric cars to Grove Hall, where the car station was inspected. From there they were taken to the central power station of the West End Company on Albany street, where an hour was pleasantly spent. In the evening a dinner was given at Young's Hotel, at which Capt. Eugene Griffin, of the Thomson-Houston Electric Company, presided. The following day was spent in visiting the factories of the Thomson-Houston Company at Lynn.

At the time of writing, a very severe snow storm is raging, probably the severst storm since the introduction of the electric car system. Up to the present, however, the electrics appear to be buffeting their way quite successfully with the snow, though it is already many inches deep. It may beat them yet, if it goes on.

BOSTON, December 26, 1890.

CHICAGO.

Testing the Interior Conduit System.—A Station That Had No Interior Conduits.—The South Side Elevated Road.—Killed by Shock.—Cheap Aluminum.

THE Illinois Chapter of Architects assembled at No. 65 Washington street last week to witness some tests made by the Interior Conduit and Insulating Company, of New York. A set of nine tests of possible combustion from electrical wires were made and examined by Chief Swenie, Prof. Barrett, Messrs. Haskins and Borden, with various members from the Board of Fire Underwriters. The results obtained were highly satisfactory. The tubes of the Interior Conduit & Insulating Company are now being very largely used for inside wiring all over the country on account of their many advantageous features, and they are also being introduced for underground work, one notable example being on the street railway at Minneapolis, where bare conductors are drawn into them, something hitherto unattempted with the ordinary forms of conduit, and are in all cases giving good success.

The Eldorado Gas and Electric Light Works were burned to the ground last week, leaving the town in darkness. The loss is estimated at $5,000, with no insurance.

The South Side Alley "L" road is negotiating an important deal with L. Z. Leiter for a tract of land fronting on Van Buren street, 40 x 80 feet, adjoining the new Leiter building. The land is near the northern terminus of the road, and it is stated that if arrangements are carried out either for a purchase or a long-time lease the "L" road will erect a new building for the general offices and the electric power house of the company. The agent of the company states that they have not yet called for any plans or specifications for a new building, and will not do so until they have located the site definitely. The work on the road is going forward in a very gratifying manner, and cars are expected to be running by May next if the same success in the future is attained as recently in securing right of way.

George Winn, superintendent of the Fire Alarm Telegraph of Allegheny City, fell from a telegraph pole last week and was instantly killed. He was repairing a wire and it is alleged received a shock, as a long burn was discovered on his body. When picked up it was discovered that his neck was broken by the fall.

Among the uses for aluminum suggested by Mr. Eugene H. Cowles, president of the Lockport company, in a recent interview are the following: At 50 cents per pound the new metal will compete with copper at 17 cents, the latter being 3.56 times as heavy as an equal bulk of aluminum. But the electrical conductivity of aluminum that is 98 per cent. pure is only 75 per cent. that of copper, so that one-third more area would be required to do the same work. A reduction of 45 per cent. in weight of motors for electric cars can be secured by using the new metal, which in itself is no small advantage, seeing that the latter promise to come into extensive use in the near future. The coating and lasting qualities of aluminum far surpass those of tin, and it will cover three times as much surface for equal weights, making it necessary to sell tin at 16 cents per pound in competition with the other at 50. Nickel at 70 cents would no longer be used for plated ware or coinage, the new metal being much cheaper and cleaner. He expects to see it sell at two to three hundred dollars per ton, and at these figures it will be the cheapest metal next to iron and steel. The price must fall lower and lower as the facilities increase for making the material, and the market adapts itself to the absorption of larger quantities of the new metal.

CHICAGO, Dec. 24, 1890.

REPORTS OF COMPANIES.

THE WESTINGHOUSE LOAN.

A special despatch from Pittsburgh of Dec. 26, says: "A meeting of the bankers and business men of this city who had loaned George Westinghouse $500,000 lately was held to-day. An advisory board of five were selected to act with Mr. Westinghouse in placing the half million and managing the affairs of the companies requiring the loan. Of the gentlemen present at the meeting seventeen banks and 30 business men of the city were represented, who had furnished the emergency loan from $2,000 to $35,000 each. At the meeting Mr. Westinghouse presented a statement of his interests as follows, the two first named being those requiring the half million loan: Westinghouse Electric and Manufacturing Company—Capital issued, $6,500,000; gross receipts, $5,000,000; net receipts, $500,000; accounts receivable, $1,436,000; material in stock at cost, $780,000; other than bonded debt, $3,339,900; Philadelphia Natural Gas Company—Capital issued, $7,500,000; gross earnings, $3,000,000; net earnings, $1,500,000; bonded and other debt, $1,990,000; accounts receivable, $700,000; material at cost, $800,000. Totals of all Westinghouse interests, comprising eight companies, among them the air brake company: Capital issued, $23,170,000; gross earnings, $16,550,000; net earnings, $4,205,000; bonded debt, $1,059,000; other debts, $6,257,900; accounts receivable, $6,297,147; material at cost, $2,560,000. In an interview one of the subscribers to the fund stated that Mr. Westinghouse was negotiating the half million loan in the East when his competitors in business prevented it. The loan was merely being made to tide over the present stringency, as the statement would show."

It is stated that Mr. Bannister, who is already associated with the Westinghouse interests in Pittsburgh, has been appointed general manager of the Westinghouse Electric Co.

DIVIDENDS.

THE MEXICAN TELEGRAPH COMPANY has declared a dividend of 2½ per cent. for the quarter ending Dec. 31, payable Jan. 7. The statement for the quarter shows a surplus above charges and dividends of $36,828, and a total surplus of $167,698. The Central & South American Telegraph Company declares a quarterly dividend of 1¾ per cent. for the three months ending Dec. 31, and made the same payable Jan. 7. The surplus for the quarter is $19,551, and the total surplus is $324,085.

MIDDLETOWN, CONN.—The Middletown Electric Light Co. have declared a 2 per cent. dividend.

BANGOR, ME.—The Bangor Electric Light & Power Company have declared a dividend of 15 per cent., covering 1888 and 1889, payable Jan. 1, 1891. This will leave a surplus of about $8,000, and the company has voted to pay semi-annual dividends of 4 per cent., commencing July 1, 1891.

STOCKS AND BONDS.

CHICAGO, ILL.—The Sunbeam Incandescent Lamp Co., of Chicago, have filed a certificate of increase of capital stock from $30,000 to $100,000.

DETROIT, MICH.—The Detroit Electrical Works have increased their capital stock to $500,000, and the issue has been eagerly subscribed for. The works are now rushed with an immense influx of orders for the popular Rae electric railway system.

TORONTO, CAN.—A new telephone company has been organized with a capital stock of $250,000.

HOLYOKE, MASS.—The stockholders of the Holyoke Street Railway Co. have voted to increase the capital stock from $50,000 to $150,000 so as to equip its several lines with electricity in the spring.

MILWAUKEE, WIS.—An issue of $2,000,000 of bonds will soon be made in order to equip the street railroads with electric power.

BOSTON, MASS.—The net earnings of the Thomson-Houston Co. for the year to end February, 1891, will, it is estimated, reach $3,370,000.

BUFFALO, N. Y.—The Bell Telephone Co., of Buffalo, has filed a certificate showing an increase of its capital stock from $800,000 to $1,000,000.

ALPENA, MICH.—The Alpena Electric Light Co. has increased its capital stock to $84,000, and will put in an incandescent plant.

BURLINGTON, VT.—The Vermont Electric Co. will increase its capital stock to $100,000 by issuing $35,000 of 7 per cent. guaranteed stock and $40,000 of second preferred 4 per cent. stock. The object of the company is to utilize the big water power above Winooski village and transmit it electrically to Burlington for light and power. E. I. Garfield is president, and W. S. Vincent and W. H. Lang, directors.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED DEC. 23, 1890.

Alarms and Signals :—

Fire-Alarm Box, J. J. Ruddick, 443,183. Filed Sept. 13, 1890.

A fire-alarm box, with clock mechanism in which a single lever for winding the clock mechanism is employed also for releasing a detent through one and the same movement.

Fire-Alarm System, F. T. Feary & J. Speleber, 443,478. Filed July 30, 1889.

A fire alarm system designed to enable private stations, other than the regular stations of the system, to send in an alarm directly to a fire-engine house in advance of regular alarm, and providing means whereby such private signal box controls the regular signal box so far as to prevent the interference of signals. The private signal box has a direct wire to the engine house.

Clocks :—

Electro-Mechanical Central System for Regulating Clocks, C. A. Mayrhofer, 443,291. Filed Dec. 29, 1888.

Claim 1 follows:

The combination, with a number of subscribers' lines extending from a central office, of a switching apparatus at the central office, a motor for operating said switching apparatus, a releasing device for said motor, and electro-magnet located in the circuit of the master-clock and adapted to actuate said releasing device so as to start the motor clocks at the residences or offices of the subscribers, devices on said clocks for switching them into the subscribers' lines, hand-setting devices on said clocks, and means for operating said hand-setting devices when the subscribers' clocks are switched into circuit with the main switching apparatus.

Conductors, Conduits and Insulators :—

Insulator, W. L. R. Emmet, 443,174. Filed Sept. 18, 1890.

A line insulator especially applicable to electric railway work. Designed for simplicity and strength and with a view of supporting the weight of the wires by strains of compression rather than by tensile strains.

Electric Insulator, F. Bain, 443,187. Filed March 25, 1890.

A design for insulators of the "petticoat" type usually made of glass or porcelain. The petticoat portion has formed upon its outer and inner surfaces a continuous series of separate circumferential sharp ridges, designed to prevent the formation of a continuous film of moisture.

Distribution :—

System of Electrical Distribution, H. A. Rowland & L. Duncan, 443,181. Filed Sept. 10, 1888.

A system of distributing continuous currents of high potential and reducing the potential at points of use, or further distribution, through the employment of secondary batteries as tension reducers. A number of secondary batteries are provided with a continuously operating commutator, by which the connections of the battery are changed, so that such batteries are alternately charged in series by the high-tension current and discharged in a current of low tension on the consumption or translation circuit. Provision is made that neither the charging nor the discharging circuit is ever broken; both are always continuous. This is accomplished by dividing the batteries into sets, and by using upon the commutator over-lapping contact surfaces, so that before the circuit of any one set is broken the circuit of another set is closed.

Dynamos and Motors :—

Machine for Dressing the Commutators in Dynamo-Machines, G. P. Cummings, 443,270. Filed April 18, 1890.

Claim 1 follows:

The combination in a machine for dressing the face of dynamo commutators, of a spindle, an encircling sleeve rotating thereon, a second sleeve sliding longitudinally upon the first and having a spline and groove connection therewith, a grinding or abrading wheel fitted upon said sliding sleeve, means, substantially as described, for attaching the spindle to the dynamo in parallelism with the commutator, and an adjustable gear for connecting the rotating spindle with the dynamo, whereby the two are made to revolve in unison.

Dynamo-Electric Machine, C. P. Scheuritzel & J. L. Hess, 443,407. Filed Feb. 5, 1890.

The invention consists chiefly in the method of winding the armature coils and placing them in position, and includes an arrangement of a plurality of brushes on the commutator for connecting with one or more of the commutator bars for the purpose of varying the current to requirements. The machine is particularly adapted for furnishing a variable current of a constant potential. The coils are wound in the form of an irregular hexagon, with long and short sides diagonally opposite each other and with parallel sides, forming the active portions of the coil, diametrically opposite each other. In one method of winding employed the armature is formed of a series of coils wound one through the other, the coils being thus linked together and forming an endless chain.

Galvanic and Thermo-Electric Batteries :

Galvanic Battery, H. J. Brewer, 443,219. Filed June 16, 1890.

Improvement in the type of batteries known as "dry batteries." The invention includes the combination of a carbon cylinder and a zinc cylinder concentrically arranged and having their open ends embedded in a sealing body of insulating material; an exciting material consisting of a compound of sulphate of lime, chloride of zinc and glycerine; also the combination of a body of solid or semi-solid exciting material and an absorbent material containing moisture.

Lamps and Appurtenances :—

Electric Street-Light, G. M. Kim, 443,097. Filed May 19, 1890.

A design and construction of a mast-arm for electric street lights.

Electrical Signaling Apparatus, A. B. Wyckoff, 443,157. Filed May 5, 1890.

The invention consists in devices for flashing an electric light for signaling or other purposes. For a lamp or group of lamps there is provided a rotating shaft having projecting arms in different planes, and segments, one for each arm, one segment serving to direct the current to the lamp or lamps and the other segment shunting the current back to the dynamo. The object is to flash the lamp instantly up to its full power and to extinguish it instantly.

Circuit Breaker and Closer, J. S. Potter & D. J. Cartwright, 443,404. Filed Aug. 16, 1890.

Design and construction of circuit-breaker and closer particularly adapted for the key-sockets of incandescent electric lamps.

Gas and Electric Light Fixture, C. Felton, 443,487. Filed Dec. 28, 1889.

A device for securing the canopy of a gas or electric light fixture in position through frictional contact.

Medical and Surgical :—

Electric Belt, J. L. Pratt, 443,226. Filed May 6, 1890.

An electric belt with a battery case at the wearer's back; the elements of the battery are joined by hooks and eyes.

Metal Working :—

Electric Welding Apparatus, H. Lemp, 443,224. Filed Aug. 6, 1890.

Improvement in the class of apparatus in which movement is given to the work while heated during the welding, upsetting or other operation. Avoids employment of sliding contacts between the clamps holding and moving the work and the contact pieces or electrodes connected with the source of current, by bringing the current bearing electrodes directly in contect with the work and moving the work by means independent of the electrode.

Claims 1 and 10 follow:

1. In an electric metal-working apparatus fixed current-bearing electrodes making contact with the work and through or by which the work slides in the welding, upsetting, or other operation, as and for the purpose described..

10. In an electric metal-working apparatus, the combination as substantially described, of a number of current-carrying electrodes consisting of reciprocating plungers operating in lines converging upon the work and adapted to make sliding contact and means for rotating the work while the plungers make rubbing or sliding contact therewith.

Electric Cash-Register, W. L. Bundy, 443,475. Filed Sept. 30, 1889.

Claim 1 follows:

The combination with a rotating multiple switch and contact fingers engaging therewith and push buttons arranged in decimal sets electrically connected at will to the fingers, of an electro-magnet and its armature, adapted to release the switch when the circuit is made by operating a button and to lock it when the circuit is broken by the rotation of the switch.

Miscellaneous :—

Cut-Out, G. W. Mingle, 443,195. Filed Aug. 1, 1890.

A safety device for telegraph, telephone or other wires to protect them against damage from contact with electric lighting or other powerful currents, or against lighting. It is an electro-magnetic apparatus for opening the circuit to be protected upon contact with a circuit carrying a too powerful current, and provided with an additional, or auxiliary, armature for the purpose of making a ground connection.

Apparatus for Painting Electric Wires and their Coverings, R. W. Heppell, 443,237. Filed Jan. 23, 1890.

A painting or coating machine, having brush-holders arranged to hold brushes in a radial position around the wire which is fed through the machine.

Electrotype, E. H. Hanson, 443,278. Filed June 11, 1889.

An improvement in the backing and blocks of electrotypes. Backing is of a different metal from the electrotype, say lead, the block is provided with grooves to receive tongues formed in the backing.

Electric Safety Device for Elevators, H. E. Holmes and C. F. Grosvenio, 443,283. Filed April, 14, 1890.

A device, including electro-magnetic apparatus, for insuring the automatic stoppage of a moving elevator when a condition of danger arrises through derangement of the machinery.

Electric Safety Device for Elevators, H. E. Holmes and C. F. Grosvenio, 443,282. Filed March 26, 1890.

An electro-magnetic device adapted to stop the motion of an elevator in transit on the occasion of the projection of any part of the person of a passenger or of any object or article on the car or platform across or beyond the floor through which the hoistway passes, or the projection of any object on one of the floors into the hoistway.

Recording Pressure-Gauge, J. B. Edson, 443,360. Filed June 12, 1890.

Claim 7 follows:

The combination, with the indicating and recording mechanism and the alarm bell and electrical appliances for operating the same, of a circuit-closer included in the circuit of said electrical appliances, and consisting of a rod connected to and actuated from the indicating mechanism, a stationary contact to and from which said rod moves, and a spring-support in which said contact is adjustably mounted.

Watchman's Time-Recorder, I. D. Fuller, 443,435. Filed July 2, 1890.

Electro-magnetic apparatus employed for operating the type-bars in a watchman's time-recorder.

Railways and Appliances :—

Electric Railway. E. M. Bentley, 443,084. Filed Apr. 9, 1887.

A system of conductors and contacts for conduit electric railways. It comprises an insulated main-supply conductor with exposed contacts at intervals, a shallow sectional metallic channel or conduit open at the surface of the street, and a contact-conductor traveling along the channel in electrical connection with both the exposed contacts of the main-supply conductor and surface conduit. The surface conduit is formed in sections insulated from each other. The traveling conductor attached to the car is in the form of a rod or wire-rope and is of a length greater than the distance between the exposed contacts of the main supply conductor.

Railway-Switch-Operating System, S. L. Powell, 443,149. Filed July 5, 1890.

Electro-magnetic mechanism for controlling the operation of switches automatically from or by a passing train or from a main station or office.

Electrically-Operated Railway-Switch, S. L. Powell, 443,167. Filed Feb. 21, 1890.

The switch bar and switch-bar actuating mechanism are set in motion and locked in given position by electro magnetic apparatus.

Mounting for Electric Motors, A. L. Riker, 443,227. Filed Apr. 23, 1886.

A mounting for motors upon cars or other vehicles.

Claim 1 follows:

A mounting for the propelling motor of a vehicle, comprising in combination a supporting frame or carriage pivoted on one of the axles, springs bearing on a portion of said frame or carriage and pressing in opposite directions, and chains arranged to limit the motion of said frame or carriage and to support the same in case of breakage of said springs, substantially as described.

Electric Railway, R. M. Hunter, 443,451. Filed Sept. 1, 1890.

A system of conductors combining overhead and surface conductors. The overhead conductor is preferably the positive and the surface or underground conductor the negative. The inventor prefers to make the surface working conductor into sections arranged upon the road surface and combined with an imbedded supply conductor and automatic switches for connecting the supply conductor with the sections of the surface working conductor in connection with one of the collectors of the motor or car.

Electric Railway, R. M. Hunter, 443,442. Filed Sept. 5, 1890.

A system of conductors consisting of two suspended bare conductors, arranged one above the other, the car or vehicle carrying two trolleys or collectors. Two insulated supply conductors are connected at intervals with the working conductors.

Printing-Telegraph, S. V. B. Essick, 443,134. Filed Nov. 7, 1888.

Improvement upon printing telegraphs, of the class printing in lines upon

a page, previously patented to the same inventor. Objects of the present invention are:—Adaptation to closed circuits; to release the paper carriage at any point of its forward progress; and improvements in pole-changing devices.

Claim 1 follows:—

In a printing telegraphic receiver, a type-wheel driven by a train of gearing, a paper carriage having advancing and restoring mechanism, and a releasing device mechanically connected to one of the gear wheels for automatically releasing the paper carriage at any point of its excursion, substantially as described.

Printing-Telegraph, S. V. B. Essick, 443,135. Filed March 10, 1890.
Further improvement of the same inventor's system. Present invention directed chiefly to details of the paper carriage mechanism.

Printing-Telegraph, S. V. B. Essick, 443,136. Filed July 5, 1890.
Further improvements of the same inventor's system. Embraces modifications of transmitting apparatus and of the printing receiver.

Telegraph Transmitter, S. W. Smith, 443,381. Filed June 2, 1890.
An apparatus for the mechanical transmission of Morse characters through the manipulation of a key-board similar to those employed in printing telegraphs.

Secondary Batteries:—

Electrode for Secondary Batteries, I. Kitsee, 443,454. Filed Feb. 11, 1890.
The electrode consists of active material in the form of a perforated plate, held in a containing frame made of rubber or other material unaffected by electricity or the acid of the electrolyte.
A suitable conductor is embedded in the active material.

Electrode for Secondary Batteries, I. Kitsee, 443,455. Filed Feb. 11, 1890.
Substantially similar to number 443,454 above.
The conductor embedded in the active material is led out through the joint of the rubber containing band which is riveted at one corner of the electrode.

Secondary Battery, I. Kitsee, 443,456. Filed Feb. 11, 1890.
A modification of the electrodes of the above two patents; the active material of the electrode, consisting of a series of blocks or plates placed edge to edge with strips of conducting material between and the whole clamped in an adjustable frame of rubber or other unsusceptible material.

Secondary Battery, I. Kitsee, 443,457. Filed Feb. 17, 1890.
Battery consists of electrodes, both positive and negative constructed on the methods shown in the above three patents of the same inventor.

Telegraphs:—

Printing-Telegraph, F. B. Rae, 443,111. Filed Aug. 9, 1888.
Adaptation of transformers to the transmission of telegraphic signals from a central station to a number of sub-stations, as in stock-reporting systems. It relates to those methods of transmission which employ upon the lines impulses of alternate polarity, and in which such currents must be capable of being arrested at any stage in order to produce the desired signals, usually requiring a prolonged current of the sign last flowing. The special object of the invention is to facilitate transmission through a considerable number of separate circuits from one transmitting machine. The primary of transformer is connected to the transmitter; the actuating magnets of a number of pole-changers, one for each line, are connected with the secondary of the transformer in multiple arc. The potential of the current from the transmitter is suitably reduced by the transformer.

Telephones and Apparatus:—

Telephone Circuit and Apparatus, J. L. McQuarrie, 443,145. Filed June 27, 1890.
Provides a metallic telephone circuit which may be common to a number of subscribers; in which each subscriber may at all times have the use of a metallic circuit and in which each subscriber may be called from the central station without giving an alarm at another station, and may also signal the central station without signaling the other stations; requires but one call-receiving instrument at the central station, and but one spring-jack or other switching device or annunciator for each double wire circuit.

LEGAL NOTES.

THE GREAT WESTERN TELEGRAPH CO. LITIGATION.—DECISION FAVORING THE OLD MILWAUKEE STOCKHOLDERS.

The Supreme Court of Wisconsin has rendered a decision of great interest and importance to a large number of Milwaukee business men and one which may save the subscribers to the stock of the old Great Western Telegraph Co. a large sum of money. The action was that of the corporation named against the heirs of George Burnham and came to the Supreme Court on an appeal from an order of the Circuit Court for Milwaukee county overruling the demurrer of the defendants. The company sought to collect an assessment of 33 per cent. on the capital stock of the corporation, 100 shares of which were held by Mr. Burnham and fell to his heirs. Twenty years ago a number of Milwaukee capitalists were induced to subscribe various amounts to the capital stock of the Great Western Telegraph Co. The projectors of the enterprise were Chicago men. It was promised that 2,000 miles of wire should be strung. Lines were erected between Milwaukee and Chicago, with branches to neighboring towns. Notwithstanding this auspicious beginning, the enterprise collapsed within a very brief period from its inception. The affair had passed out of the minds of the stockholders. Their suprise was, therefore, the greater when they were served with notices by a Chicago attorney that suit had been commenced in the Supreme Court of Milwaukee county to collect an assessment upon the capital stock of the Great Western Telegraph Co. It was found that the debts and other obligations of the company aggregated something like $500,000, to pay which the courts of Illinois have authorized a levy of 35 per cent. upon the stockholders. It was set forth in the complaint, copies of which have been served upon the Milwaukee stockholders, that the subscriptions still constitute the means and fund for the prosecution of the corporation's business and the payment of its debts, that for a valuable consideration each of the defendants undertook and promised to pay for each share subscribed for by him the sum of $25, that the subscribers number 2,000 persons, living in twelve different States and territories, and that the subscribers neglect or refuse to pay the balance due from them to the capital stock of the company. The Milwaukee subscribers to the stock, when notified that suits were commenced, combined to fight the cases, and demurrer was made in the Burnham case. The Supreme Court now reverses the ruling of the Circuit Court of Milwaukee county, where the case is pending, on the appeal from the order overruling the demurrer of the defendants.

EDISON GENERAL ELECTRIC CO. vs. EDISON ILLUMINATING CO., OF CUMBERLAND, MD.—SUIT FOR DELIVERY OF STOCK DISMISSED.

Judge Bond, of Baltimore, signed an order dismissing the bill in the above suit. The case was in the United States Circuit Court, brought before it in November, 1889, and was argued before Judge Bond by Mr. Lewis, of New York, and Edgar H. Gans, of Baltimore, for the plaintiff, and E. J. D. Cross, of Baltimore, and A. Hunter Boyd, of Cumberland, for the defendant.

The plaintiff, says the Cumberland *News* of Dec. 20, is the parent company of the Edison system, and claimed in this suit that it was entitled to $5,340 of the stock of defendant under a contract made between the two companies when the contract was formed. Defendant claimed that the plaintiff was not entitled to the stock. The claim of the plaintiff was based upon a provision in the contract which provided that in case the Cumberland company gave any liens the plaintiff was to receive thirty per cent. of the amount in stock of the Cumberland company, this 30 per cent. being part payment for the use of the plaintiff's patent. When the Cumberland company had completed its plant as originally contemplated, it found that it was necessary to make further improvements and additions in the way of purchasing new engines, boilers, dynamos, etc., and the plaintiff claimed that it was entitled to 30 per cent. of the cost of these improvements. The Cumberland company had paid the royalty on the original plant and objected the payments on improvements and the dismissal of the plaintiff's bill will terminate this suit in the defendant's favor, and will relieve it of a claim that had a tendency to interfere with the Cumberland company making such improvements as it might otherwise have made in the past.

THE ADAMS CO. TO SUE.—A CLAIM OF PRIORITY IN ELECTRIC RAILWAY MOTOR PATENTS.

A special dispatch from St. Louis, of Dec. 26, says:—"It is announced here that the Adams Electric Railway Co., of St. Louis will within the next two weeks enter suit against the Thomson-Houston, the Sprague, the Short, and other electric railway companies whose systems are now in successful operation for infringement of patents covering the fundamental principle of propelling cars with electricity as the motive power. The claim upon which these proceedings are to be based is the official record of the Patent Office Department in Washington, backed by legal opinions from the mercantile patent lawyers in the country to the effect that the Adams Co. holds the patent under which every successful electric railway system of the country is now being operated."

ELECTRIC ACCUMULATOR CO. vs. BRUSH ELECTRIC CO.—AS TO DISMISSAL OF A SUIT.

A decision by Judge Henry B. Brown, of Detroit, who has just been appointed an Associate Justice of the Supreme Court, was filed in the United States Circuit Court at Cleveland, O., on Dec. 27. The case was that of the Electrical Accumulator Co., of New York, against the Brush Electric Co., of Cleveland, and the decision is upon the request of the Accumulator Company to dismiss a suit against the Brush Co., and upon the demurrer made by the Brush people to amended and supplemental bills of the Accumulator Co. Camille A. Faure was granted a patent on his secondary battery Jan. 3, 1882, and a month or two afterward a patent was granted on almost exactly the same invention to the Brush Co. The Faure patent passed to the possession of the Electrical Accumulator Co., of New York, and this concern began a suit against the Brush Co. to procure an adjudication of the invalidity of the Brush patent.

A demurrer and answer were filed by the Brush Co. affirming the validity of its own patent and denying the validity of the Frenchman's patent. The Accumulator Co. proceeded to take prima facie proofs and the Brush Co. to take its answering proofs. Then the Accumulator Co. filed a supplemental bill setting forth that the first claim of the Faure patent had been adjudged to be valid in the Circuit Court of the Southern District of New York. The supplemental bill alleged that since the filing of the disclaimer, the Faure and the Brush patents had not been interfering within the meaning of the law, and asked the court to dismiss the case.

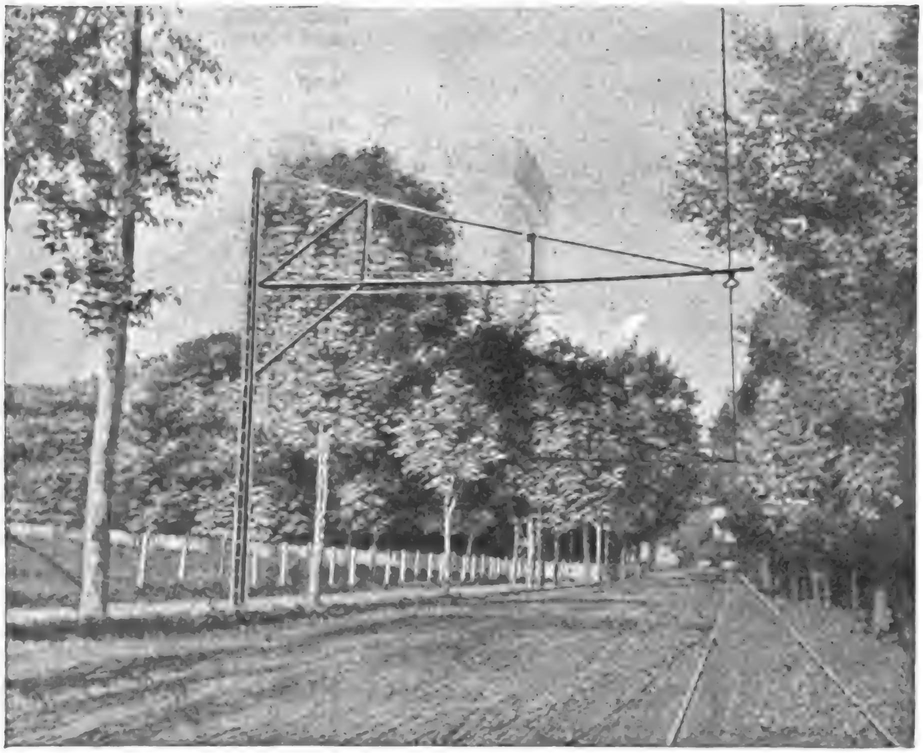
The Brush Co., however, objected to having it dismissed and denied that the two patents were not interfering. After citing many decisions Judge Brown said he had come to the conclusion that leave to dismiss a bill should not be granted where the action would be manifestly prejudicial to the defendant. The petition to dismiss the case was, therefore, denied.

TRADE NOTES AND NOVELTIES

AND MECHANICAL DEPARTMENT.

THE LARGEST ELECTRIC STREET RAILWAY POLE IN THE WORLD.

The cut on this page represents the largest electric street railway pole in the world. It was furnished by Messrs. Millikin Bros. to the Passaic, Clifton and Garfield street railway, at Passaic, N. J., only four of them being in use. The road runs its track on one side of the street and some of the property owners objected to placing poles on the curb line, so the owners of the road were compelled to place the poles on the opposite side of the street and throw an arm all the way across. This presented a difficult engineering feat and the parties, after giving the facts to Messrs. Milliken Bros., left them to design and execute the work. There were many serious difficulties to contend with in the support and bracing of an arm of such length on a single pole without the use of any guy wires from the pole to the ground. They used their usual form of pole and made the segments unusually heavy and extended the lacing from the bottom of the pole to the top.



THE LARGEST STREET RAILWAY POLE IN THE WORLD, PASSAIC, N. J.

The general dimensions of the pole are as follows: Length of pole, 35′ 0″; length of arm, 32′ 8½″; height of arm above the ground, 20′ 1½″; distance of pole in the ground, 7′ 0″; the pole is designed to carry 500 lbs. on the end of the arm and its total weight is 2,000 lbs.

The arm is built of angles and plates with proper struts and rods, most of which had adjustment. The arm was also braced in a horizontal plane on the lower chord, and the end of the arm has a loop and the same at a point near which it connects to the pole. This is intended for a No. 6 wire to be stretched from one pole to the end of the next arm to hold the arm against vibration, but we understand that for some reason this was omitted and not used. An ornamental acorn top was also arranged for, but when the photograph was taken it had not been put on. A sliding bracket to adjust the centre of the trolley line over the centre of the track is also provided.

The owners in writing to these parties in relation to other matters stated that these poles, although subjected to an unusually heavy strain, stood perfectly erect and were entirely satisfactory. We understand that Messrs. Milliken Bros. are even prepared to furnish larger poles than these if street railway work demands it.

MR. G. W. MANSFIELD, the expert of the Thomson-Houston railway department, delivered a most interesting lecture recently before the Business Men's Association of Pawtucket, on the subject of electricity, illustrating his remarks with frequent experiments.

LARGER QUARTERS FOR "A. B. C."

Whatever dullness is rumored to be prevalent in mercantile circles seems to have overlooked the supply trade, or at least a part of it. This is shown by the fact that the business of Alexander, Barney & Chapin, who opened their supply store in the Telephone Building, No. 20 Cortlandt street, only two and a half months ago, has increased to such an extent that they have been obliged to take in another whole floor, equally as large as their original capacious warerooms. As this firm has devoted itself particularly to the electric light and power trade, and in fact has covered the country from the east to the west and north to south, they handle specialties in immense quantities, and although the goods keep circulating—as one lot goes out another coming in—they have almost since their opening day found themselves overcrowded. They have accordingly called on their landlord for extra accommodations, and although space is scarce in Cortlandt street and room is valuable, have finally gotten the large basement under their store, which has hitherto been used by the Telephone Company.

This basement it is thought will be sufficient for six months, anyway, and it will be used as a storehouse, packing and shipping department. It and the floor above will be connected with an electric elevator, which will have the double advantage of being practically useful in the daily routine of business, and also of demonstrating to their numerous customers the working of this kind of apparatus.

INGENIOUS CATERING FOR PRIVATE TRADE.

Mr. J. M. Lennon, 22 Loan and Trust building, Minneapolis, who is now able to announce himself as agent for 31 electric companies, has issued the following ingenious circular to ladies in his locality, who are likely to need advice as to electrical decorations, etc: "Yourself and family are invited to call upon me when in need of an electrical expert's advice or assistance in installing and fitting any of the multitude of electrical conveniences, decorations, etc. And I should like very much to call your attention to the beautiful and æsthetic use to which the miniature Edison lamps may be put, either in the drawing-room, library, dining or other rooms. I have had a great amount of experience in this line and I am certain that the designing and fitting of at least one room in your home will both please and attract you. I can guarantee to leave your home in as perfect a condition as when entered, no matter how fine or frail the rest of the furnishings may be. Much use is being made of these small lamps by the elite in the East, in England and France. I also fit and design any of the finer grades of electrical apparatus, but cheap and gaudy fittings I will not do, as I do not care to do work for any but the elite of the Northwest."

QUEEN & CO.'S VANE AMMETERS.

Queen & Co., of Philadelphia, have recently taken an order for a "magnetic vane" ammeter, capacity 1,350 amperes. The instrument will have a dial some 12 inches in diameter, encased in a heavy japanned iron circular box. This is the largest ammeter that the firm has undertaken, and will, no doubt, be a handsome addition to the switchboard of the Central Passenger R. R. Co., at Louisville, Ky. Queen & Co. are also making "magnetic vane" ammeters with capacities of 300, 400 and 500 amperes for such companies as the Brush and Edison. These instruments have dials about 8" across and are mounted in iron or brass cases as ordered. They are used by the above companies on their finest switchboards where it is desired to have meters in harmony with the other work.

On the magnificent switchboard of the steamer "Plymouth" may be seen two of Queen's "magnetic vane" ammeters, capacity 400 amperes each. These instruments have been advertised but little as yet, but the demand is large and increasing, as the makers of dynamos are beginning to realize that in order to show up their apparatus in the most advantageous manner it is necessary to send out with each installation, first-class ammeters and voltmeters.

Queen & Co. also report a brisk demand for Ayrton & Perry ammeters and voltmeters, which are largely used as portable instruments.

THE BAIN BREAK INSULATOR.

The insulator illustrated below is designed to take the place of the ordinary devices that have been used as break insulators. The new insulator is made of one piece of porcelain, carefully glazed, and is so simple as to require scarcely a word of explanation; while its great strength and perfect adaptability are sure to commend themselves to all practical construction men. This insulator will be found especially useful, also, for suspending arc lamps from iron cranes, insulating guy wires, and particularly, for insulating span wires in electric railroad work.

THE BAIN BREAK JOINT INSULATOR.

The Central Electric Company, of Chicago, control the patent and are placing the device upon the market.

"NEW PROCESS RAW HIDE" STREET CAR PINIONS.

The question of gears for electric cars is a most important one, and is beginning to receive from the street railway companies the attention it deserves. There is still much to be learned. Thus, for example, discussing the topic of raw hide gears, the New Process Raw Hide Co., of Syracuse, say: "To the inexperienced buyer the term "raw hide" seems to cover all that is tough, noiseless and desirable for gears to be run at a high rate of speed. This is an error. By our patented process of treating the hides we are able to remove all that is useless, only retaining the actual fibre to the full extent of its strength. No other process known can do this, and while to the casual observer one raw hide gear seems as good as another, yet by actual test we are as far ahead of the ordinary makes as steel is ahead of iron. Both may have pretty much the same general appearance, but a comparison is not to be thought of. Beyond our patented process of preparing the hides we have the only patent in existence for a gear with face entirely of raw hide, and these in conjunction put us into the field with an armor well calculated to protect and save us from the shafts of our competitors, and give us the preference so well deserved."

The company are recently in receipt of the following communication from the Wichita, Kansas, Electric Railway Co:

"Replying to your favor of Dec. 6th, will state we have used your raw hide gears off and on since last May, together with various other kinds of pinions. We believe that your raw hide pinions are the best in the market at the present time.

"The first one we put on in May 1890; this pinion was in service seven months, and was not then entirely worn out. Yours very truly. Signed. Thos. G. Fitch, General Manager."

A PORTABLE PHOTOMETER FOR CENTRAL STATIONS.

Heretofore photometer work has been but little practiced by managers of central station plants, one reason being the cost of the apparatus, and another its apparent more intimate connection with the laboratory than with the manufactory and salesroom of electrical illumination. The first objection (if it may so be called) has been overcome, however, and as regards the second, the sentiment has now veered around and the demand for photometrical measurements in practical work is becoming well established. Alexander, Barney & Chapin are now introducing a portable photometer, which is noticeable chiefly for its inexpensiveness and adaptability for general work. The lantern is so made that when not in use it can be thrust entirely into the photometer box. When in use it is placed upon an ordinary photographic tripod; it can be reversed so as to allow for difference of vision of two eyes. When not in use, slides cover the ends of photometer and sight box, while a handle on one side allows of convenience in carrying. The range of the measurements is from about 7 to 2,000 candle power.

The method employed in measuring is as follows:—Place the lamp to be measured in front of the opening in the photometer box, away from the standard candle. Move the lamp to and fro until the diaphragm is illuminated equally on both sides, then measure the respective distances of the standard candle and the lamp from this point. Employ the formula $S : L :: A^2 : B^2$; in which S is the standard, L the lamp to be tested, A the distance of S from the diaphragm, and B the distance of L from the same point. For convenience the standard candle is usually placed 1 foot from the grease spot, in which case A may be ignored in the formula. Thus, if a standard of 1 candle be used, and the lamp is four feet from the spot, the proportion will be $1 : L :: 1 : 16$. The lamp therefore gives 16 c. p. In measuring lamps of high candle power it is sometimes not convenient to place them at the necessary distance from the photometer, in which case it is best to use two standard candles, which reduces the distance to one-half. For testing arc lamps suspended in the street, it is necessary to reflect the light by means of a mirror into the photometer box.

This apparatus is sold by Alexander, Barney & Chapin, of the Telephone Building, 20 Cortlandt street, this city, who have already put out quite a number. We illustrated it May 14, 1890.

THE RAE ELECTRIC RAILWAY SYSTEM.

The Detroit Electrical Works are now running double time to meet the demand for their Rae electric railway system, orders for which pour in from all sides. An evidence of the approval enjoyed by the system is seen in the second order from the Galveston road, for ten cars, making 30 Rae cars in all, or half the full complement of the road. The cars already in use are running nicely and the new ones are wanted as soon as possible.

THE GREAT WESTERN ELECTRIC SUPPLY CO., of 190–193 Fifth avenue, Chicago, ask all who have received quotations from them to cancel same, and to write for new ones on any supplies they may need. In the near future they will issue a new catalogue and discount sheet, which will be forwarded to all their friends and patrons, so as to give them promptly the benefit of the new prices.

THE HIMMER AND ANDERSON DRY BATTERY CIGAR LIGHTER.

ONE of the recent uses of the popular dry battery is that shown in the accompanying cut of a cigar lighter just brought out and placed on the market by the Himmer and Anderson Dry Battery Co., of this city. It should certainly displace the match box and its elusive contents. It has a couple of dry batteries inside the case, with a spark coil in the rear and the sparking terminals in front, as indicated, above a small tray and immediately under the winged head. The case is of ornamental wood, surmounted by a stag or other desirable piece of bric-a-brac or stationary. As will be seen this is a portable, handy, lighter, as convenient as anything of the kind could well be.

"MAKE IT PAY."

Edwin L. Burdick & Co., of Buffalo, N. Y., under the above title, have issued a very pithy little brochure devoted to a discussion of advertising and of the merits of the *Roller Mill* as a medium in its special field. The remarks on advertising are most excellent. Its motoes are of the kind that deserve to be posted on the memory, and lived up to by every advertiser who would get the worth of his money. The *Roller Mill* is a paper of high reputation and large circulation, and is not only a recognized authority but is a model of typographical beauty and finish, of which Burdick & Co., its energetic publishers, may well feel proud.

COLUMBIA INCANDESCENT LAMP CO.

The above company of 1912–1914 Olive street, St. Louis, Mo. has just issued a tasteful catalogue and price list of its incandescent lamps. The cover is adorned by a graceful figure of Columbia holding up a lamp deriving current from a dynamo at her feet, and the inside pages are freely illustrated with cuts of the various sizes and styles of lamp, for Sawyer-Man, Edison, United States, and Thomson-Houston sockets. Lamps are also made for Swan, Hawkeye, Queen City, Fort Wayne, Schaefer, and other sockets, and old lamp bases will be refilled, with an allowance for the base. The company is also manufacturing a special lamp for use in electric cars, the filament being so mounted as to prevent mechanical injury from vibration. The company's factory is fully equipped with the latest appliances and tools, and superiority for the product is claimed on the ground of its candle power, long life and high efficiency. J. H. Rhotehamel is the president and manager.

MORE CHANGES ON "THE ELECTRICAL WORLD."

Our contemporary, *The Electrical World*, published in this city, announces that it has made further changes in its *personnel*, having secured for its New York offices the services of Messrs. F. De Land, W. Hazen and J. F. Dillont. They take the place of Mr. Clarence E. Stump, who has lately withdrawn from that paper, of which during so many long years he had been the faithful and efficient business manager, a capacity he will now fill for the progressive *Street Railway Journal*. Of the newcomers, Mr. F. De Land is the only one known in electrical journalism, and his many friends, among whom we gladly count ourselves, will desire for him personal success under the circumstances that have necessitated his removal to the East. To him and his new colleagues in the conduct and management of the paper, we beg to extend our wishes for their happiness—and long tenure of office.

NEW WESTINGHOUSE CONTRACTS.

Since the first of December, the Westinghouse Electric and Manufacturing Company has received contracts for alternating current electric lighting apparatus for a capacity of 5,650 incandescent and 120 arc lights. Olean, N. Y., has contracted for an increase of its plant and when the new apparatus has been installed, the plant will have 1,400 incandescent lamps' capacity. The alternating current electric lighting plant of the Missouri Electric Light and Power Co., in St. Louis, Mo., has grown so rapidly that it has now become one of the largest central station plants of alternating current electric lighting in the United States. The company was organized in the early part of 1887, with apparatus of a generating capacity of 12,000 lights. This was the first contract for Westinghouse alternating current apparatus which had come from St. Louis. The other systems of incandescent lighting of the larger companies in America were already in operation in that city, but nevertheless, the Missouri company found a very ready demand for its lights, and the success of the plant was assured from the very start. This fact very soon manifested itself when the management found that the supply at the central station was not sufficient to satisfy the demand any longer and an increase had to be made in the generating capacity. A 3,000 light Westinghouse alternating current dynamo was added and for a time the immediate wants of the company's patrons for lighting were complied with. But it was only temporary and then the company added two more 3,000 light Westinghouse alternating current dynamos to the capacity of the station.

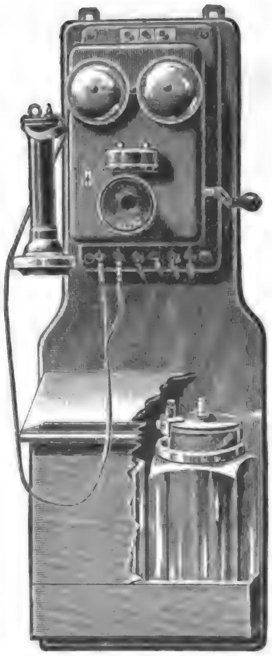
The company now had a generating power by which it was enabled to furnish 21,000 sixteen c. p. incandescent lamps, which made it the largest electric lighting plant in St. Louis, but the new system of lighting had by this time gained such a popularity among the people of the city that the supply was again taxed to its utmost capacity until a few days ago, the Westinghouse company received another contract for the installation of one of its 3,000 light apparatus. This will give the Missouri Electric Light and Power Co. alternating current apparatus with a generating capacity of 24,000 incandescent lamps, which makes it the largest alternating current central station plant in America, west of the Allegheny mountains.

The Pennsylvania Railroad Company is rapidly increasing the number of electric light plants along its lines, where a good light is of the greatest consequence and advantage to the railroad. Some time ago, the Westinghouse Electric and Manufacturing Company installed a plant of its alternating current arc light apparatus at the Altoona shops. The operation of that system has given such satisfaction that the railroad management lately decided to have a similar plant put up at Wall station, which is one of the most important points on the entire Pennsylvania Railroad system. The plant will have a capacity of 120 arc lamps.

The electric light plant at Wilmerding, Pa., the new town near Pittsburgh, where the Westinghouse Air Brake Works are located, is now being increased from a capacity of 1,500 to 2,000 lights.

THE BERLINER "UNIVERSAL" TELEPHONE TRANSMITTER.

The "Universal" transmitter was designed by Mr. E. Berliner with a view of supplying an instrument which would be efficient both as a microphone for short lines and with only one cell of Leclanché battery as well as on the longest commercial lines where



BERLINER "UNIVERSAL" TRANSMITTER.

several Fuller, or Bunsen, or accumulator cells become necessary.

It is well known that the Blake transmitter works excellently on shorter lines and when these are in first-class condition. But when the lines are leaky or troubled by induction from neighboring lines the "Blake" loses its power to give satisfaction, particularly as the construction does not admit of the use of larger battery power owing to the liability of the contact to "stick" or burn.

Many attempts have of late years been made to supplant the "Blake" by a multiple contact transmitter or one in which carbon granules enclosed in a chamber are used, but thus far, with the

exception of the "Universal," hardly one has succeeded entirely in supplying at the same time sharpness of articulation, facility of speaking at leisure away from the mouthpiece, economy of battery, and foremost, the avoidance of clogging or "packing" of the carbon granules.

It is true that for some time a "long distance" instrument has been in use in the United States, but it is necessary to speak close to it and with one cell of Leelanché it is not superior to the "Blake." It also requires frequent shaking up, although this should not form a serious cause for complaint.

In the "Universal" all the requirements of a first-class transmitter are combined and all sources of annoyance have been eliminated. With one cell of Leclanché it is superior to the "Blake" and will carry the voice over a defective line where the "Blake" utterly fails. With three large Fuller or Bunsen cells it retains its purity of intonation and produces a volume of sound which on lines several miles long would still fill a lecture hall when a funnel-resonator is applied.

It may be spoken to either three to six inches from the mouthpiece in an ordinary tone of voice, or, if necessary, close to it with the loudest voice.

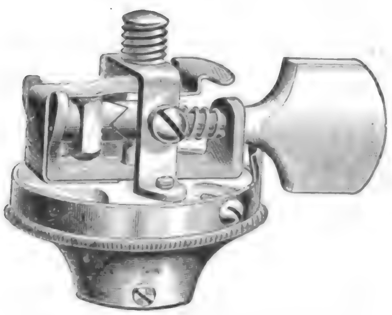
Its internal parts, diaphragm chamber and granules are all carbon, with a thin covering of mica to prevent the breaking of the diaphragms The granules, when viewed under a lens, show rounded corners and the resistence of the mass is lower than that of other masses of granules used for this purpose. A striking novelty is the use of a soft rubber mouth-piece which helps making the instrument sensitive without adding a bad quality to the articulation.

Special care is bestowed on the induction coil so that even governments who from motives of patriotism favored transmitters made by their home talent, ordered coils made in Hanover to use in connection with the "Universal."

It is almost to be expected that the many years of experience which Mr. Berliner has brought to bear on his first invention should enable him to produce an instrument which has now and then been approached in certain points, but which taken as a whole has no match or rival among the many forms of transmitters which have been designed after Mr. Berliner first incorporated the principle of loose contacts into the science of telephony. The Tropical American Telephone Co. has the exclusive export agency for the "Universal" long distance telephone sets.

THE "E. E. & S." KEY SOCKET.

The E. E. & S. key socket, manufactured by the Electric Engineering & Supply Co., of Syracuse, N. Y. is adapted by slight modifications for use in connection with the Thomson-Houston, Edison and Westinghouse systems. One of the chief features



THE "E. E. & S." KEY SOCKET.

wherein it differs from other key sockets is that the insulating parts consist entirely of air spaces, and a peculiar quality of porcelain so tough that the parts may be riveted to it without breaking the porcelain.

The end to which the lamp is attached has an air space insulation doing away with fibre or other insulation used in connection with most other sockets. The base of the "E. E. & S." key socket is of porcelain, which is a tough non-absorbent porcelain practically indestructible.

The make and break arrangements are governed by a peculiar form of clutch operating a cam which throws the silicon-bronze contact spring, producing a slight wiping contact. The break is very sudden, owing to the peculiar operation of the clutch mechanism and is expedited by the operation of the contact spring itself as well as a small spiral spring, which produces a very quick break. The motion, however, is a positive make, with the sudden break, which owing to the lost motion on the clutch mechanism is as rapid as can be produced by parts operated by the two springs.

Another peculiar feature of this socket is the finely finished china porcelain key which is free from the softening experienced in keys when exposed to somewhat high temperature.

The good features of this key socket have already created such a demand for the article that the manufacturers been obliged to operate their factory nights and have already ordered more than double the present equipment of machine tools to put into their new factory. This they hope will enable them to keep up with their orders for this and their other electric lighting and railway specialties.

NEW ENGLAND TRADE NOTES.

MR. L. H. ROGERS, New England agent for the Brush Electric Co., has sold a 600 light Brush alternator to the Manchester Gas & Electric Light Co., Manchester, N. H. The station has been laid out to accommodate two more alternating dynamos of 1,000 light each. A 500 horse-power compound condensing engine is being installed.

THE STANDARD ELECTRIC CO., OF VERMONT, have sold a 500 light plant to the Olcutt Falls Co., Olcutt Falls, Vt.

THE PORTER MANUFACTURING CO., of Syracuse, N. Y., manufacturers of the well known Porter engines and boilers specially adapted for electric lighting purposes, have opened a branch office at 218 Congress street, Boston, with Mr. W. S. White as manager. Mr. White has been for eight years master mechanic for the Cocheco Print Works, Dover, N. H., is thoroughly conversant with all classes of engine work, and is well known in New England. A full sample stock of engines and boilers will be kept, and orders for the smaller engines will be promptly attended to from the Boston office.

MR. E. M. CARHART, of Providence, R. I., well known in New England as having been for years general manager of the Rhode Island Electric Protective Company, of Providence, having severed his connection with the above company, has sent out notices to his numerous friends and former patrons that he has opened an office at the old address, 18 Customhouse street, Providence, under the name of E. M. Carhart & Co., where they will carry a stock of new and most improved supplies for electric lighting. Among their specialties will be the new Thomas mast arm and the Thomas tree iron. All kinds of electric wiring for light, bells, annunciators, burglar alarms, etc., will be done, and it is contemplated establishing a new district patrol system for fire and burglar alarm in the city of Providence.

WESTERN TRADE NOTES.

MR. H. R. NOYES has resigned from the managership of the Chicago Electric Club and will return East to his home in Boston, where he will assist his father Judge Noyes in the management of his many large interests there. During Mr. Noyes' occupancy of the post of manager he has become a universal favorite and has made for himself a host of warm friends amongst the electrical fraternity.

MR. W. PEYTON SULLIVAN will succeed Mr. Noyes as manager of the Chicago Electric Club. He has been identified for many years with the paper manufacturing trade in Europe and this country, and was, till his coming to Chicago about a year ago, a resident of Ypsilanti, Mich. He has since been connected with the Chicago office of the Pond Engineering Company, as assistant to Mr. Albert Blanchard, the widely known manager of that company. Mr. Sullivan is eminently fitted for the position and will no doubt ably look after the club's interests and the management are to be congratulated on their selection as is also Mr. Sullivan upon his connection with the club which is in a most flourishing and prosperous condition.

THE KNAPP ELECTRICAL WORKS report business as very brisk and the outlook for the coming year as most flattering. They are constantly receiving large orders for the famous Grimshaw white core and other wires and cables, Perkins' lamps and the other specialties which they handle.

MR. GEORGE CUTTER has gone East on a three weeks' trip and will return undoubtedly with many new specialties for electrical work and also plenty of orders for the same from his many friends and patrons all over the country. He is devoting his time to handling specialties of merit and his quarters in the Rookery are filled with all kinds of new and useful devices many of which are the outcome of his own fertile inventive genius.

THE ELECTRIC MERCHANDISE CO., 11 East Adams St., Chicago, have just issued to their numerous patrons a handsome little illustrated circular calling attention to a few of their new specialties. Mr. Stevens' "Positive Gravity" switch, a new fuse-box, the Mason lightning arrester and a novel and advantageous platform gate for street cars are all clearly shown and their many merits brought to notice.

THE HAZLETON TRIPOD BOILER CO., No. 170 Twenty-second street, Chicago, report business good and prospects for the coming year very encouraging. Their recent sales include shipments to Mexico, Montana, Washington and Wisconsin, and they are now erecting two 500 h. p. boilers in Youngstown, O., and the second 500 h. p. for the Citizens' Street Railway Co., of Indianapolis; also two 400 h. p. and one 350 h. p. for the electric road in Rock Island.